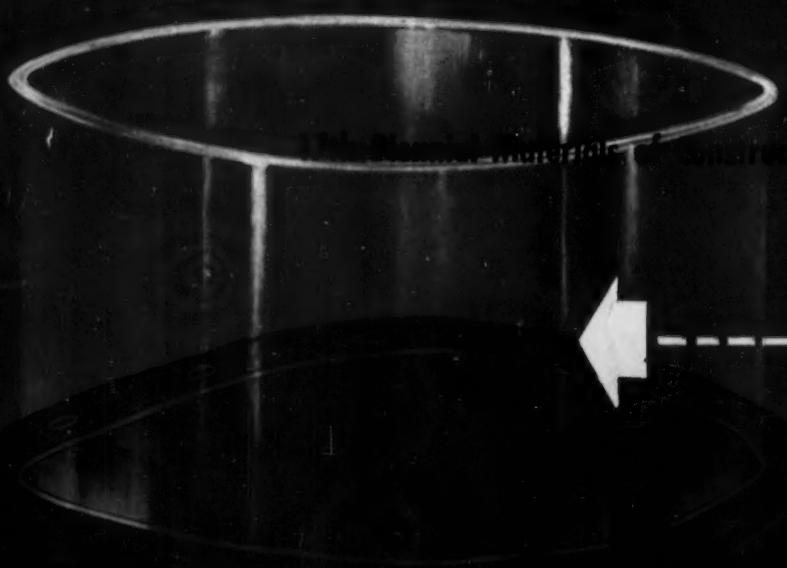
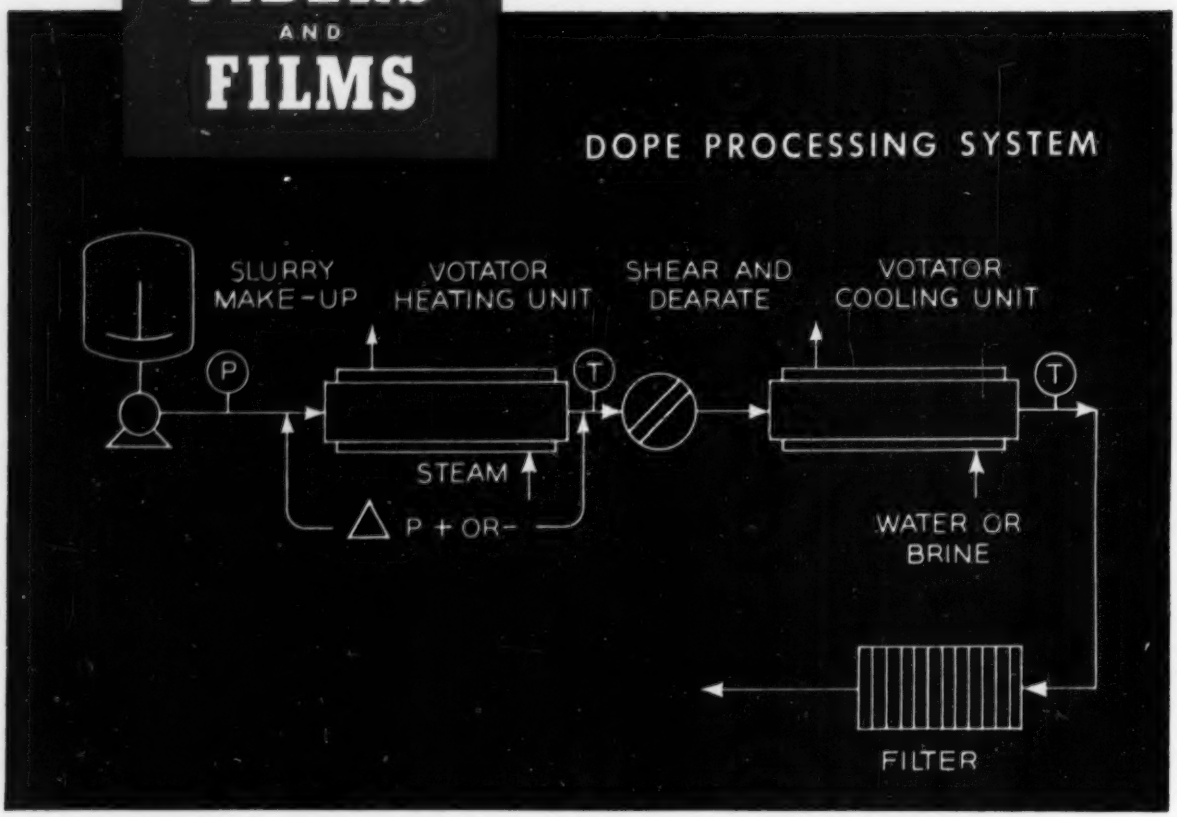
Chemical Engineering



PROTECTIVE LININGS

FOR PROCESS EQUIPMENT

FIBERS AND FILMS



How to improve processing with new *Votator*® apparatus

Heat-sensitive fiber and film materials of high viscosity are being processed better, at lower cost with VOTATOR Apparatus. A new mutator shaft design of this scraped-surface heat exchange equipment makes possible these advantages.

- **Processes a higher viscosity range than conventional methods.**
- **Eliminates overheating of heat sensitive materials.**
- **Eliminates exchanger "plug-up" resulting in less down time.**
- **Low pressure drops or pressure gains reduce pump maintenance.**
- **Floor space savings.**
- **Continuous automatic operation reduces labor costs and holds maintenance to a minimum.**
- **Greater efficiency reduces utility cost.**
- **On many applications ceramic and other inert materials have been used in mechanical seals with good results and are always available.**
- **Long service life and minimum maintenance due to the new unique shaft design which practically eliminates wear.**
- **Equipment may be obtained in corrosion resistant materials of construction.**

Applications include polyacrylonitrile and acrylic copolymers, viscose (rayon and cellophane), cellulose acetate, cellulose ethers and polyesters.

The experienced engineers and laboratory facilities of Girdler are at your disposal to help apply this improved processing equipment to *your* problems. Write for copy of Bulletin V248.

*VOTATOR—Trade-Mark Reg. U. S. Pat. Off.

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NOVEMBER 1956

John R. Callaham, Editor

Why Don't We . . .?

Readers sometimes ask why we don't publish more on their particular industry or special field.

Truth of the matter is we don't even try to cover detail developments within each of the 21 chemical process industries; that's the function of "vertical" publications specializing in one particular industry (such as plastics, ceramics, petroleum refining and the like).

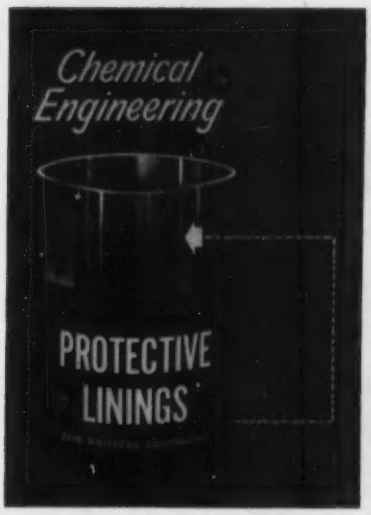
We do, naturally, make an effort to cover the really significant chemical engineering developments in each of these industries.

But CE's prime function as a "horizontal" magazine is to keep its readers *everywhere* abreast of basic chemical engineering developments and new techniques that can be used *anywhere* in the chemical process industries—to cross-fertilize ideas, so to speak, among fields as well as among functions.

An alert chemical engineer in the pulp and paper field, for example, should read at least two technical publications: a good "vertical" one for all the details on what's happening within his own industry, a "horizontal" one (such as CE) to keep abreast of across-the-board chemical engineering developments, trends and techniques common to all the chemical process industries.

Any publication that tries to be all things to all people within all the chemical process industries ends up by being little to anyone anywhere. In fact, no chemical publication even tries to do such a blanket job.

That's why we remain basic and "horizontal" in our approach.



GUIDED TOUR

New comprehensive guide to protective linings is a CE "first"

Long life for process equipment often depends on picking the right lining material as well as getting it into place properly. CE's 17th biennial report on materials of construction tells you how. It's the first comprehensive guide to protective lining systems. (p. 175)

Another shortcut for designers

Those heat-balance calculations are going to be easier now for process and design engineers working with synthesis gas. Two easy-to-use charts give you pound-mole enthalpies of constituents. (p. 208)

Solving a most critical problem

With chemical processes nosing into the 10,000 to 50,000 psi. range, common flang-

Please turn page

Chemical Engineering

NOVEMBER 1956

GUIDED TOUR

ing methods are obsolete. Here's an approach to this critical problem. It's fresh, simple and reasonable. (p. 212)

Reactor design is different

There aren't any handy correlations that you can use to predict the course and the hourly yields of a reacting system. But our three-part attack on the problem will update your design methods. (p. 215)

Toward better metering

If you know how, you can make your venturi independent of downstream pressures. Here's a way to get improved accuracy in measurement and control of process streams and other fluid flow systems. (p. 221)

Why are they worth so much?

It's only human to wonder how some executives can come up with annual salaries of more than $100,000. A look at the jobs and at the men needed to fill them explains those big paychecks. (p. 238)

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To keep pace with advances in development, design, production and technical management in the chemical process industries, more engineers subscribe to Chemical Engineering than to any other magazine in the field. Total net paid circulation of this issue:

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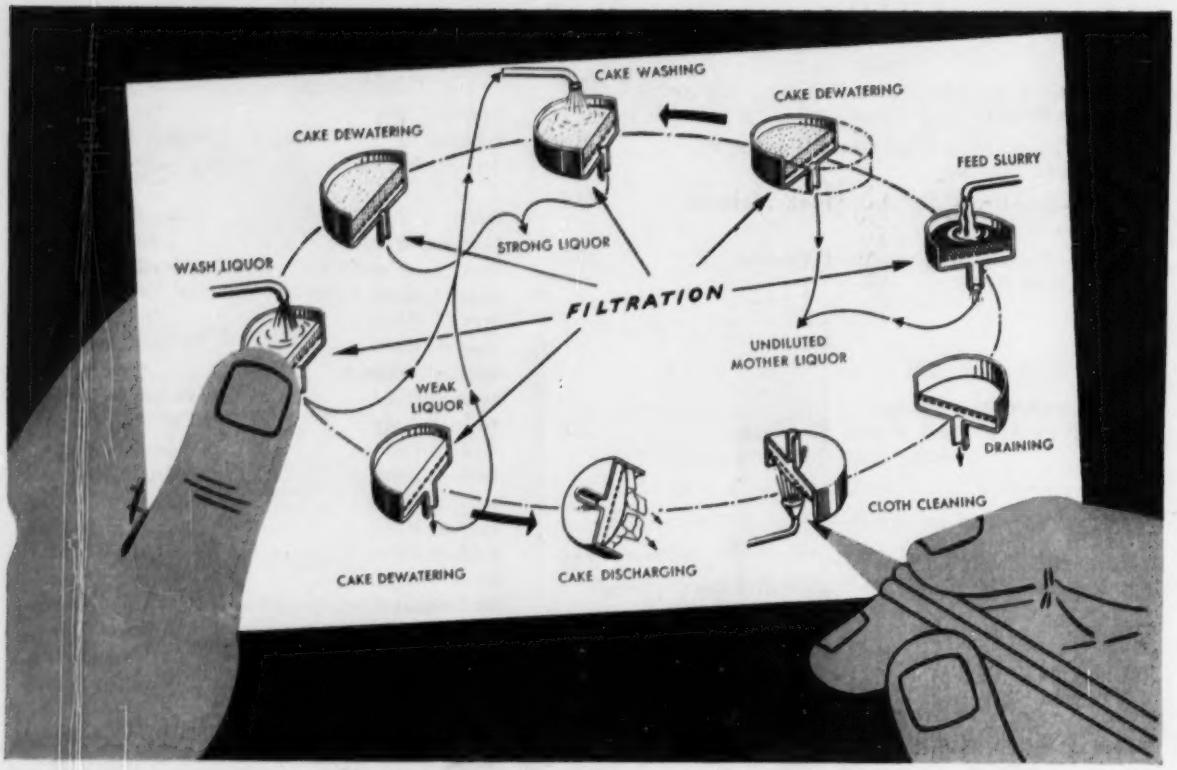
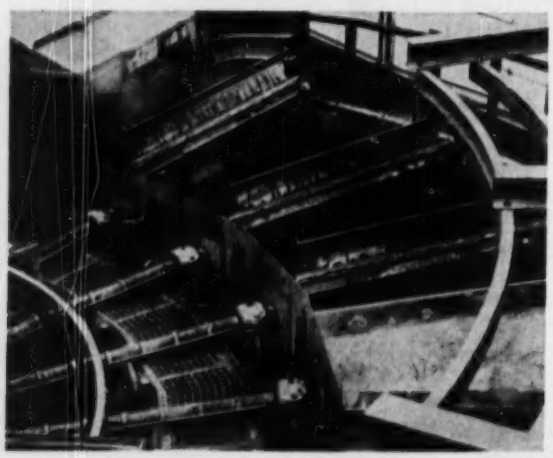


It's like having a brand new filter and filter cloth every time you put the slurry in the pan **WHEN YOU FEED IT TO THE**

BIRD-PRAYON

CONTINUOUS TILTING PAN VACUUM FILTER



Look at the automatic filtration cycle, sketched, and you'll see what we mean.

The pans are inverted 180° and the cloth blown, scoured and dried each time around. Cake removal is complete.

This is only one of the advantages of the Bird-Prayon Filter. It is ideal for handling coarse, heavy solids. And there's nothing like it when you want a super-efficient, countercurrent wash in multiple stages with minimum wash water and complete separation of mother liquor and all wash liquors.

Fifteen years of extensive, successful application are back of the Bird-Prayon Filter. That experience and the unsurpassed test facilities of the Bird Research and Development are at your command. Why not look into it?

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Builders of
- Bird Continuous Centrifugal Filters
- Bird-Prayon Continuous, Rotary, Horizontal Vacuum Filters
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- Bird Horizontal Tank, Vertical Leaf Pressure Filters
- Bird-Humboldt Screen Type Centrifugal Dryers
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For specific information on individual machines write:
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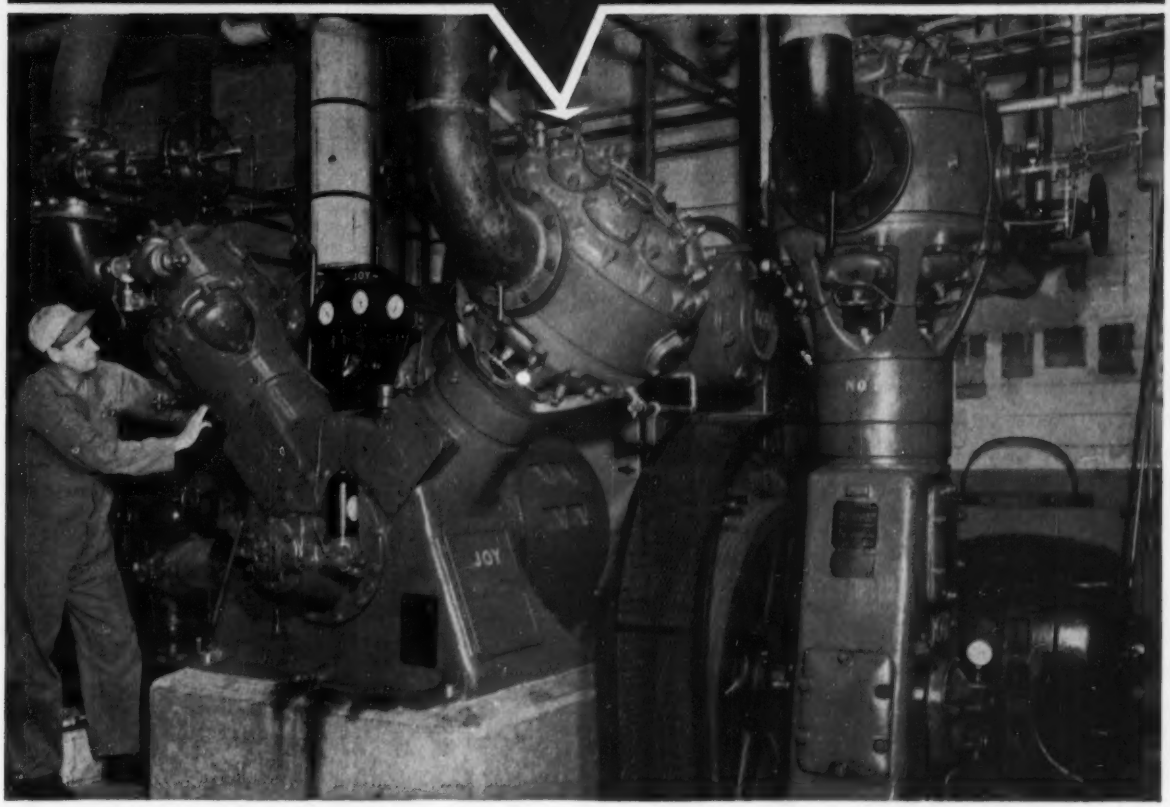
They Needed More Oil-Free Compressed Air But Had Limited Space

A Third Joy Unit Solved it!



A West Coast Company needed more oil-free compressed air . . . in a hurry! However, there just wasn't any space in the boiler room for additional machines. They had been operating two Joy WG-9 OL vertical compressors (the machine at right in the photo). These non-lubricated compressors had run continously . . . 24 hours a day . . . for *17,000 hours with no down time.*

So they again called Joy in on the problem. The solution: One WG-9 OL with 75 hp was taken out and replaced with a Joy WN-112 E-OL rated at 150 hp. This 974 cfm machine supplies plenty of air for the new equipment, yet is compact enough to fit into the small space available.

If you need oil-free air take advantage of Joy's more than 25 years of experience with non-lubricated compressors. Write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Co. (Canada) Limited, Gal, Ont.*

Write for FREE Bulletin 130-11

Consult a Joy Engineer

For Air and Gas Compressors, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors.

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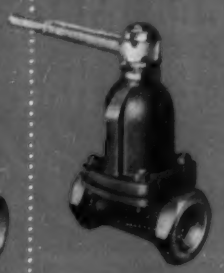
JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

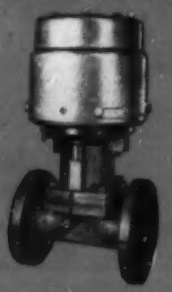
ALL-PURPOSE VALVE

for handling materials as diversified as corrosive fluids, gases, beverages, viscous materials, foods, compressed air, solids in suspension.

Handwheel Operated



Lever Operated



Power Operated

Grinnell-Saunders Diaphragm Valve

Unsurpassed on lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors.

In industries as varied as mining, food, textile, pulp and paper, beverage, water and sewage, chemicals . . . Grinnell-Saunders Diaphragm Valves continue to win enthusiastic acceptance. The unique design of the valve — with its flexible, long-wearing, tight-closing diaphragm — offers many unusual advantages.

If you have a valve problem, it will pay you to write Grinnell for further information.

Choice of Materials

Bodies — iron; cast steel; stainless steel; Durimet 20; Hastelloy A, B, C; bronze; Monel; aluminum; PVC (polyvinyl chloride); Saran

Body linings — hard rubber; soft rubber; neoprene; glass; lead; plastics; Heresite; Lithcote

Diaphragms — soft natural rubber; natural rubber; white synthetic rubber; neoprene; reinforced neoprene; butyl; Hycar; Teflon; Kel-F; PVC (polyvinyl chloride); polyethylene

Bonnets — iron; stainless steel; bronze; other materials on special order

Choice of Bodies

Conventional weir type

Straight bodies — screwed; flanged; socket weld; butt weld; socket (solder); sanitary threads; hose ends; Victaulic

Angle bodies — screwed; flanged; socket weld

Other types

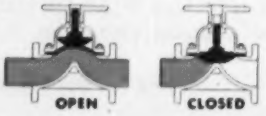
A line of Straightway Valves (for straight-thru flow) and Full-Bore Valves (for ball brush cleaning) also are available

Choice of Bonnets

Handwheel (non-indicating stem, indicating stem); chain wheel; lever (for quick operation); sliding stem (for a wide selection of power operated topworks)

Operating Features

- diaphragm absolutely isolates bonnet mechanism from the fluid in the line
- diaphragm lifts high for streamline flow in either direction
- diaphragm presses tight for positive closure
- simple maintenance — diaphragm easily replaced without removing valve body from line



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WHENEVER PIPING IS INVOLVED

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Another new development using

B.F.Goodrich Chemical *raw materials*

Pipe and fittings of Geon are joined easily with solvent cement, simplifying installation.

Now ships shower themselves

to wash away radioactive contamination

NUCLEAR explosions produce a deadly byproduct—radioactive fall-out. As a counter-measure, the Navy has devised a washdown system which enables a ship to spray itself with thousands of gallons of sea water, washing away contamination within minutes.

First, metal piping was tried for the system—but it added too much weight. The answer was found in rigid vinyl plastic pipe, made of Geon polyvinyl materials. This piping weighs but one-fourth as much as metal. It's impervious to sea water's corrosive effects, unaffected by either freezing or tropical temperatures. And, using simple but strong solvent-welded joints, it's so easy to install that the ship's crew can do the job easily. The washdown system was developed by the U. S. Navy's Bureau of Ships. The Grinnell Company, Inc. was the principal contractor in this effort.

This is only one of the many applications of Geon polyvinyl materials, ranging from rigid products like ductwork to flexible products like upholstery, from coatings for textiles and metal, to foam for cushioning and crash padding. Investigate this remarkable material for *your* products.

For more information write Dept. DB-11, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, O. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

Seamless fittings with all the plus values...at no extra cost

Your corrosion piping system can be designed better, assembled faster, made light and tight by using *FLOWLINE* fittings, butt-welded to straight-cut pipe. Available from stock through leading distributors. Made in sizes ½" through 12" — Schedules 5S, 10S, 40S, 80S — Stainless Types 304, 304L, 316, 347; Monel, Nickel, Aluminum.

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World's Largest Manufacturer of Stainless Welding Fittings

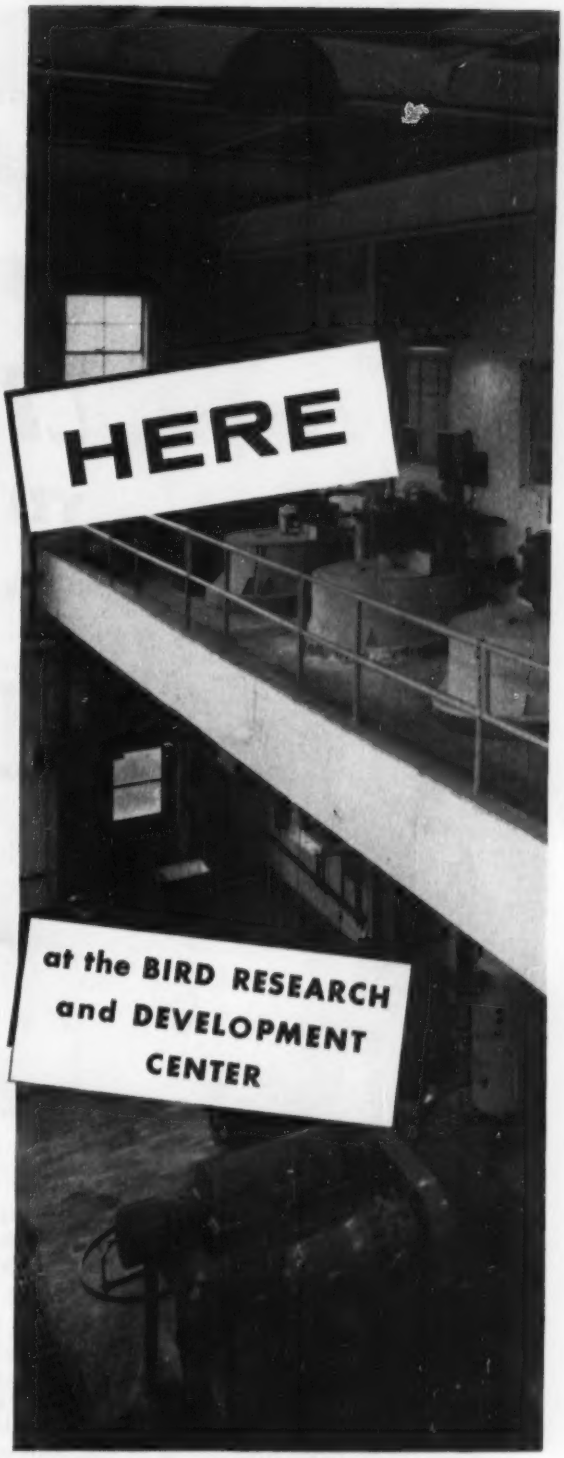
Remember **FLOWLINE®** WELDING FITTINGS

Forget CORROSION PIPING PROBLEMS

find the best filter for YOUR flow sheet

before you buy a filter and install it in your plant

You can be sure of getting the right filter the first time (no more trial-and-error; no more wasted time and money) when you let us start the processes of elimination and selection here . . . .



Pilot scale tests are quickly made, under conditions closely approximating full scale operation in your plant. You get the answers on dryness, wash, throughput, operating and maintenance costs — all *before* you spend the money for equipment.

Findings are held in strictest confidence. Recommendations are dependable and unbiased because Bird builds the most complete range of solids-liquids separating equipment.

BIRD

Leading Authority on Solids-Liquids Separations

Builders of
- Bird Continuous Centrifugal Filters
- Bird-Prayon Continuous, Rotary, Horizontal Vacuum Filters
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For specific information on individual machines write:
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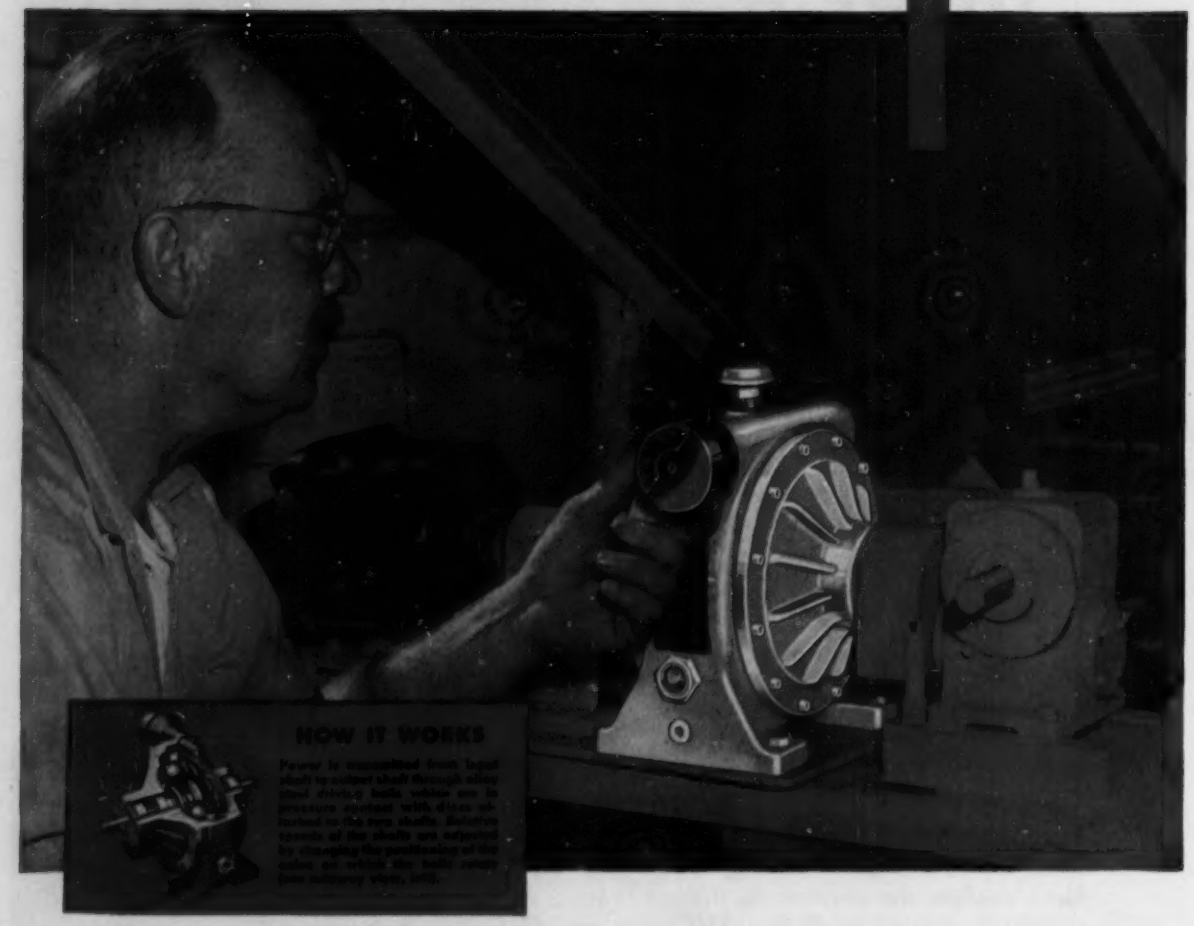
Portland, Oregon

Major chemical producer meters flow of catalytic agents with Cleveland Speed Variator

A chemical research worker adjusts the manual control knob on the Cleveland Speed Variator to set the metering speed. Various types of regulating mechanisms can be mounted on the Variator to provide automatic adjustment by remote control.



IN the research department of a major chemical plant, catalytic agents are metered and their flow varied with precision accuracy. This control is exercised with a Cleveland Speed Variator.

A ¼-horsepower electric motor is connected to the Cleveland Speed Variator driving a pump through a 25-1 speed reducer. Being infinitely variable, the Variator gives stepless speeds over its full 9:1 range—from ⅓ to 3 times input speed. Pumping speed can be varied from 207 to 23 rpm. This provides the necessary speed range for metering the various types of catalytic agents.

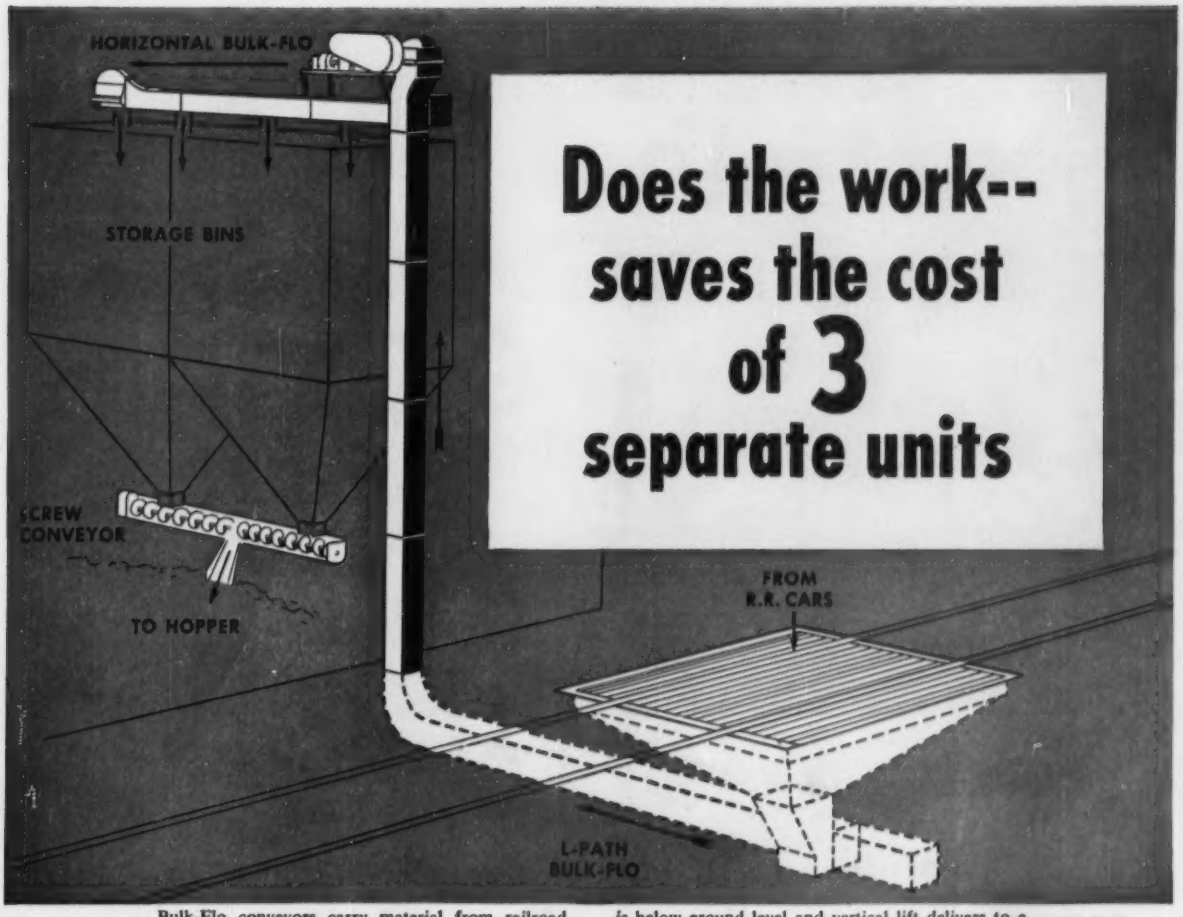
Available in eighteen standard types and sizes, the Cleveland Speed Variator offers these major advantages: 1. An extremely compact unit; 2. Almost any input speed up to 1800 rpm—clockwise or counterclockwise; 3. Constant horsepower output over a 9:1 range, or constant output torque with a 6:1 range; 4. Infinitely variable over entire speed range; 5. Rapid response to speed change, precise adjustment, accurate maintenance of settings; 6. Long life and minimum maintenance; 7. Ample bearing support for overhung pulleys on either input or output shafts.

Write for Bulletin K-200 for detailed description of the Cleveland Speed Variator, with photographs, sectional drawings, rating tables and specifications.

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3275 East 80th St., Cleveland 4, Ohio

Sales representatives in all major industrial markets. In Canada—Peacock Brothers Limited.



Bulk-Flo conveyors carry material from railroad cars to storage bins. Horizontal run of L-path unit is below ground level and vertical lift delivers to a horizontal Bulk-Flo on the roof.

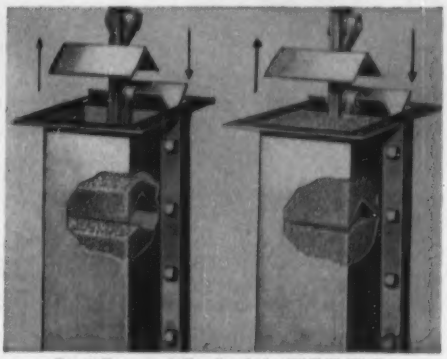
LINK-BELT BULK-FLO

feeds • conveys • elevates

HERE'S a single, compact conveying medium that combines three vital functions. It's the Link-Belt self-feeding Bulk-Flo that moves a wide variety of materials horizontally, vertically, on an incline, or combinations of all three.

Granular, crushed, ground or pulverized materials of a non-abrasive, non-corrosive nature are handled gently in individual self-clearing compartments. Even friable materials are safely conveyed . . . with a minimum of breakage, degradation, dusting or contamination. Two basic styles are available—one for lumpy materials, the other for free-flowing materials.

There's a wide range of designs that can be engineered to match your system requirements. For complete information ask your Link-Belt office for your copy of 28-page Data Book 2475.



Partially or fully loaded, BULK-FLO provides positive, gentle movement of material. Unlike conventional designs, BULK-FLO's capacity can be varied by regulating feed to meet demand changes.

LINK-BELT

BULK-FLO FEEDERS • CONVEYORS • ELEVATORS 14,004

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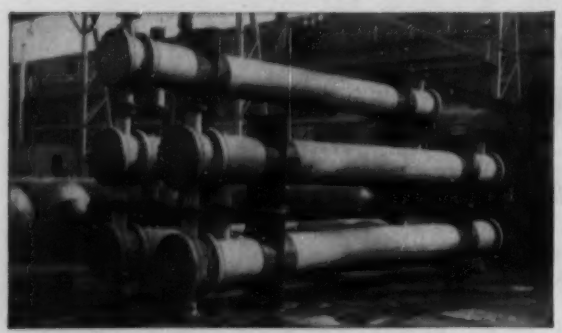
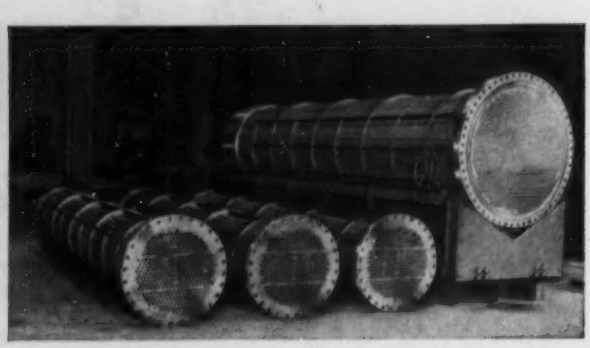
Inconel and stainless heat exchanger built for Barrett Division, Allied Chemical & Dye Corporation. Shell Diameter: 30". Tube Length: 12' 0". Tubes: 1" O.D. x 14 ga. Tube Sheet Thickness: 2". Materials: Inconel shell, tubes, tube sheets. Stainless steel heads, Type 316L.

Stainless steel plus nickel alloy equals corrosion-resistant heat exchanger by Downingtown



Aluminum bronze for these five coolers saved the customer 25% on equipment costs, assured corrosion resistance. Each fixed tube sheet unit is 20" in diameter x 20' tube length. Each has 282 aluminum bronze tubes ¾" O.D. x 12 ga. Centrifugally cast channels. Design pressure: 150 p.s.i. on both shell and tube sides.



Stainless steel Type 304 is the material for these four tube bundles. The large one fits a 37" shell, has 1225 stainless tubes, ¾" O.D. x 14'0" long. Tube sheet: 2⅞" thick. Baffles: ⅜" thick. The other three bundles are 22" in diameter; each contains 352 tubes ¾" O.D. x 16 ga. x 12'0" long. Tube sheets: 1¾" thick. Baffles: ¼" thick. All stainless steel.

Corrosion-resistant materials a heat exchanger specialty at Downingtown

We have the engineering, welding and fabricating experience to turn out your corrosion-resistant exchangers in the materials you specify: stainless, nickel, nickel alloy, aluminum bronze, carbon and many others. Our design recommendations often save money. Send for Bulletin HE. Your engineers will find it useful.

Downingtown Iron Works, Inc.

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION

140 Wallace Ave., Downingtown, Pennsylvania—Branch Offices:

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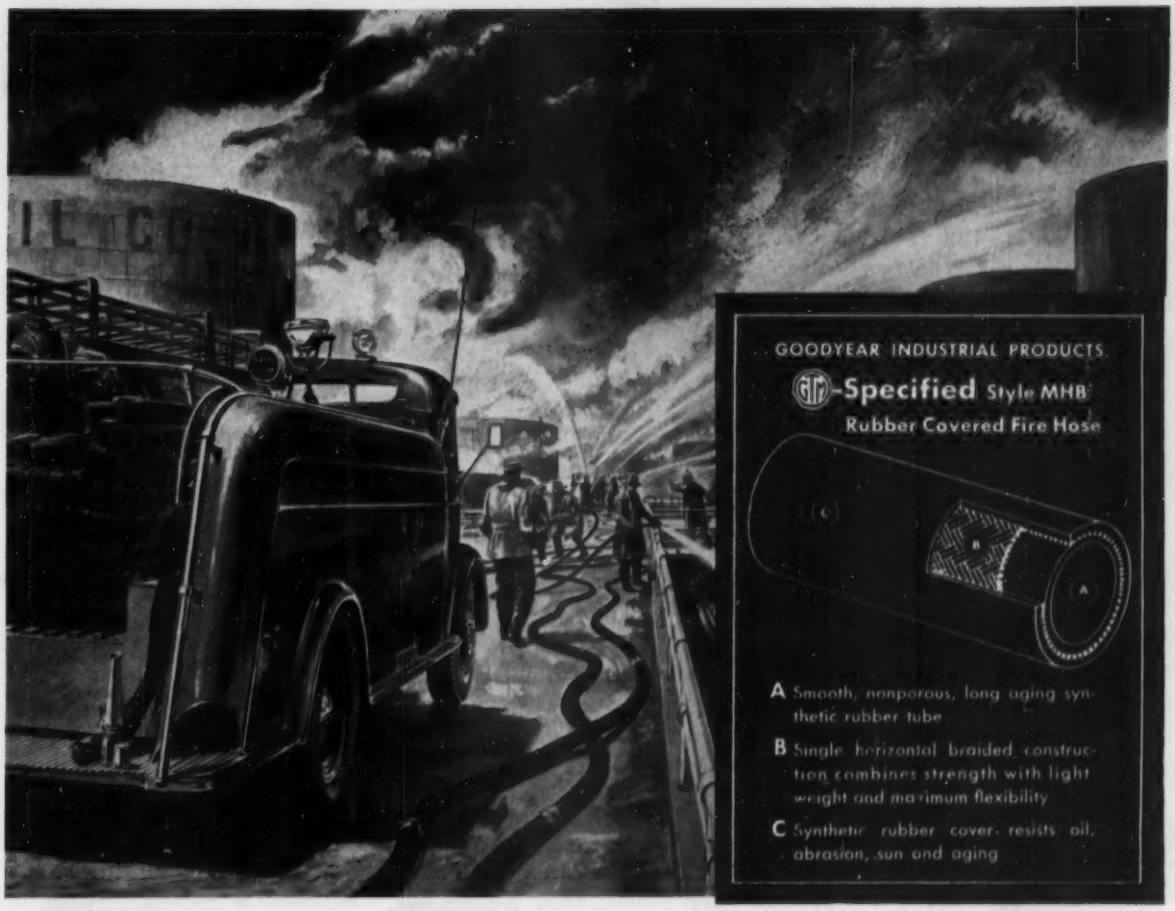
Division of Pressed Steel Tank Company, 1447 S. 66th St., Milwaukee 14, Wis.

DOWNINGTOWN IRON WORKS Hackney

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS


GOODYEAR INDUSTRIAL PRODUCTS
G.T.M.-Specified Style MHB
Rubber Covered Fire Hose
A Smooth, nonporous, long aging synthetic rubber tube
B Single horizontal braided construction combines strength with light weight and maximum flexibility
C Synthetic rubber cover resists oil, abrasion, sun and aging

G.T.M. offers the hottest thing in fire hose

THERE has long been need for a tougher, lighter weight fire hose with greater resistance to oil, abrasion and weather – especially around refineries and on oil transport vessels.

After thorough analysis of the problem, the G.T.M.–Goodyear Technical Man–and his colleagues, came up with the answer. It is a completely new hose – Style MHB Rubber Covered Fire Hose.

This new rubber hose is exceptionally flexible and light in weight. It is reinforced with a horizontal braid of high tensile synthetic fiber for extra strength. It is mildew inhibited throughout. And its specially developed rubber cover not only resists oil but snagging and hard wear as well.

If you want fire or wash hose that's built to withstand the toughest service, consult your Goodyear Distributor and/or the G.T.M. Or write, Goodyear, Industrial Products Division, Akron 16, Ohio.

RUBBER COVERED FIRE HOSE by

GOODYEAR

THE GREATEST NAME IN RUBBER

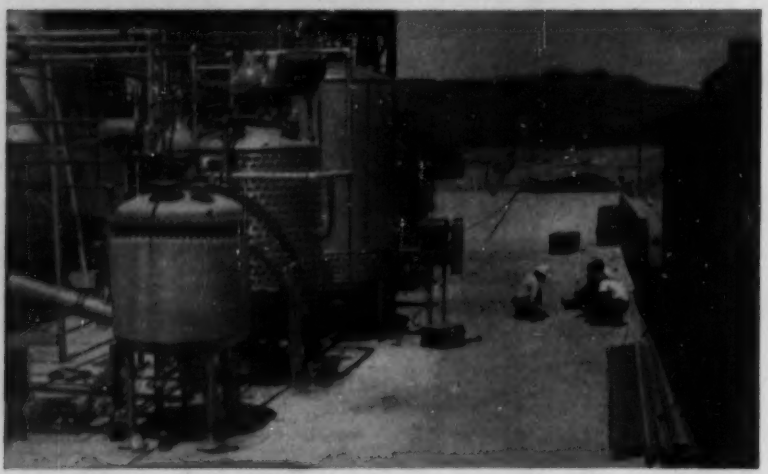
IT'S SMART TO DO BUSINESS *with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."*

EXTRA FAST DELIVERY
of standard Pfaudler glassed reactors now!
SEE BACK COVER THIS ISSUE.

Pfaudler

Pfaudler Corrosioneering News Published by The Pfaudler Co., Rochester, N.Y.

Pfaudler helps Felva set up new Mexican detergent plant



THE HEART OF FELVA'S PLANT. Pfaudler equipment lined up here (left to right) consists of a 300-gallon sulfonator, 1000-gallon neutralizer, and a 3000-gallon slurry storage tank. A side-entering mixer keeps the slurry in motion. The pipe-like equipment slanting off to the left of the sulfonator is a Pfaudler heat exchanger. And on the extreme left is a partial view of the stainless cooler. Some of this equipment must withstand the highly corrosive effects of oleum. Pfaudler glassed steel and alloy equipment prove equal to the task.

Productos Quimicos Felva—synthetic detergent manufacturer of Hermosilla—began operations in June. The event culminated a two-year program of planning and building.

To our southern neighbors, the event was especially significant. Felva's plant represents only the second of its type to be owned wholly by Mexicans. To you it most likely represents the kind of contribution corrosioneering makes to the processing industries.

Here's what Pfaudler's project engineers did for Felva: They furnished complete installation instructions including site preparation, general layout, and piping drawings—together with some of the electrical drawings. They furnished specifications for the concrete and suggestions for Felva to use in negotiating plant construction contracts. They furnished on-the-spot aid during the erection and start-up stages. And one of Pfaudler's engineers even prepared design sketches of a water spray cooler, railroad tank car unloading platform, and other appurtenances to the plant—even though these were not the responsibility of *The Pfaudler Co.!*

That's the kind of engineering service you can get from Pfaudler's project engineers. Skilled in the corrosioneering of all types of processing equipment, they're well qualified to help you with *your* processing problems.

To learn more about this unique service, contact your nearest Pfaudler representative. Or mail the coupon and receive your copy of the "Buyer's Guide."

Pfaudler Annual Report available

Our fiscal year—a highly successful one—ended May 31. A report of Pfaudler's activities during that year is now available to those of you who share our interest in Pfaudler's progress.

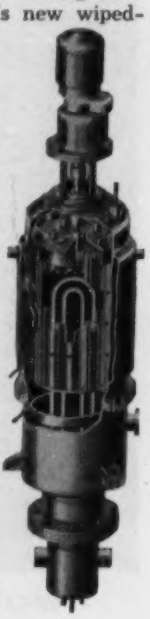
Mail the coupon today for your free copy of the 1956 Pfaudler Annual Report.

Unique new vacuum still helps probe new profit areas

You can test your own product—and in that way uncover areas of greater profit—with Pfaudler's new wiped-film evaporator for vacuum distillation.

A floating carbon blade cleanly wipes the peripheral evaporating surface to promote a very thin film and turbulence—creating higher heat transfer rates and faster evaporation.

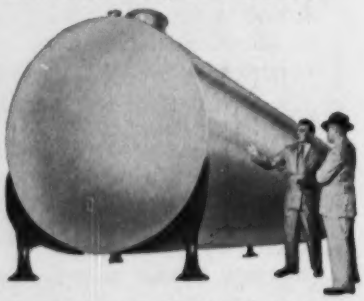
Two models are available now: a two-inch laboratory evaporator and a 12-inch pilot plant unit. For more information, contact your Pfaudler representative.



Right — Twelve inch pilot plant evaporator. Vacuums to 0.1 mm or lower; temperatures up to 700° F.; very high capacities.

CHEMSTOR spells low-cost storage

New vertical design added to line



Store your product in inexpensive Chemstor tanks—the glassed steel tanks that cost only 25 cents per gallon of capacity in the larger sizes. Size range is 750 to 35,000 gallons. You get the corrosion resistance of glass *plus* the working strength of steel. Nothing beats glassed steel for keeping your product free from contamination. Chemstor tanks are easy to clean—almost nothing sticks to glass!

For further information, check Bulletin 918 on the coupon and mail it in today.

Corrosioneering News

Quick facts about services and equipment available to help you reduce corrosion and processing costs.

How to cut time *and* cost of your centrifuging

It's no longer necessary for your centrifuging to be an expensive and time-consuming "batch" type operation.

With a Titan Superjector Centrifuge, you get:

- *continuous* removal of solids from one or two liquids
- *continuous* concentration of solids by removal of liquid from slurries—and discharge of solids in a pre-determined dry state.

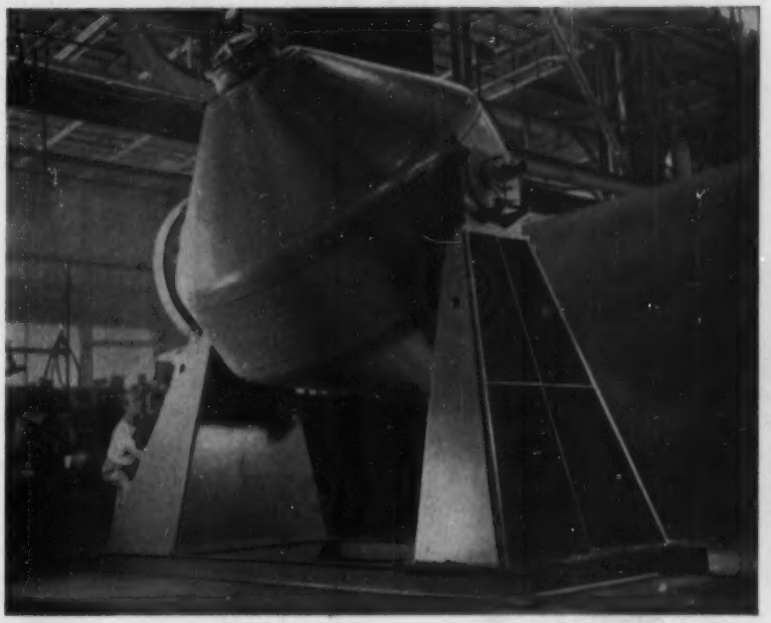
While rotating at full speed, the Superjector discharges solids deposited within the centrifugal bowl and *thus cleans itself*. You benefit from reduced labor costs, increased production, and improved product!

Once you see the uniqueness of its design, you'll understand just how economical and time-saving the Titan Superjector can be. Bulletin 930 gives you full details.

Nickel-clad columns

Here are two nickel-clad columns designed for petrochemical service. The unit on the left is 46 feet long, the other 56 feet. Pfaudler's experience with both glassed steel *and* alloy columns qualify our engineers as impartial assistants to you in *your* column selection problems. Make doubly sure you order the *right* column by checking with us before you buy.

Send for Bulletin 940 and Data Sheet No. 25.



Big new conical dryer-blender speed-dries 165-cubic-foot batch!

Now you can speed-dry larger batches of highly corrosive products than ever before. The enormous working capacity of this giant dryer-blender permits fast drying of up to 165 cubic feet of material.

You get more than just a *dryer* with the Pfaudler unit—you get a dryer-*blender* that offers these important benefits:

- **Higher Heat Transfer** through uniformly narrow jacket space.
- **Lower Power Requirements** because units of this design are unencumbered by "extra" water in the jacket.
- **Improved Heat Transfer** due to the much greater *jacket surface area* than you'll find in other units.
- **Corrosion Resistance** of acid-alkali-resistant glassed steel.
- **Even Drying *and* Blending** produced by established method of *proper* tumbling.

You'll enjoy all these benefits with any Pfaudler conical dryer-blender. Exclusive features of the big new *eight-foot* dryer-blender include 1) lubricated stuffing box, 2) gear-driven unit, 3) 15-hp. explosion-proof motor *with magnetic brake*, and 4) *pre-formed* stand.

On the right is a close-up view of the new drive unit. There's no possibility of "bucket rolling" with this unit because of the new magnetic brake. Normally turning at eight rpm, the bucket alone—fully charged—weighs ten tons!

Learn more about this unique dryer-blender. Mail the coupon and receive without obligation your copy of Data Sheet 26.

THE PFAUDLER CO., Dept. CE-G-11, Rochester 3, N. Y.

Please send me: ☐ Buyer's Guide. ☐ Pfaudler 1956 Annual Report. ☐ Bulletin 918—Pfaudler Chemstor Tanks. ☐ Bulletin 930—The Titan Superjector. ☐ Bulletin 940—Columns *Glassed Steel & Alloy*. ☐ Pfaudler Data Sheet 25—Columns. ☐ Pfaudler Data Sheet 26—Dryer-blenders.

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Company.....

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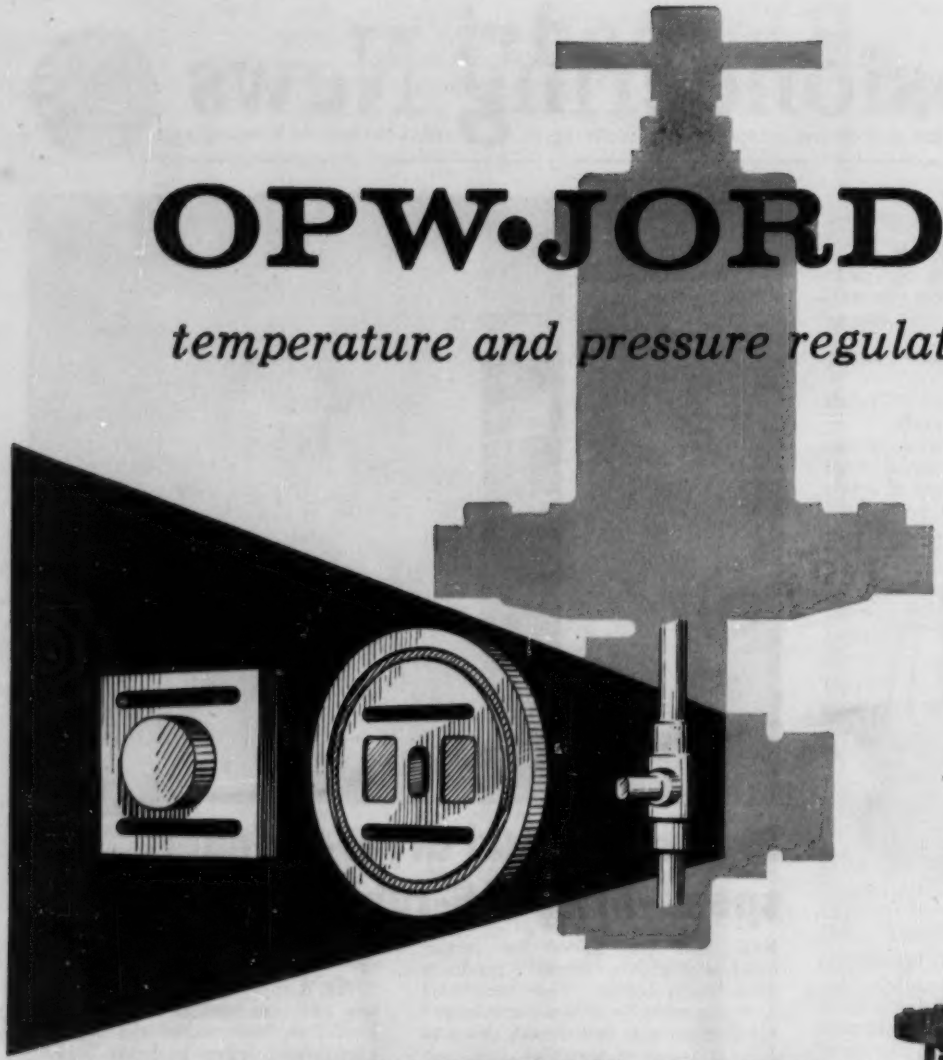
City..... Zone..... State.....

OPW•JORDAN

temperature and pressure regulator valves



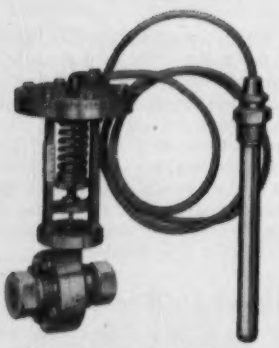
with the patented **SLIDING GATE***

*the heart of the OPW-Jordan Valve specifically designed to overcome wire drawing, valve leakage, poor control, chatter, excessive maintenance.

Unusual sensitivity, dead end shut-off, close control, self-lapping action. Metallic diaphragm—no lubrication necessary.

Investigate all of the advantages of OPW-JORDAN SLIDING GATE. Superior in design and performance!

'JORDAN's Trade Mark for its variable orifice plate seating construction.



NO. 180 SELF-OPERATING TEMPERATURE CONTROL VALVE

Holds temperature constant within ±2½° of set point. Most versatile temperature regulator valve . . . broader applications, fewer limitations. Available in ten standard temperature ranges within the outside limits of 35° Fahrenheit to 450° Fahrenheit. Suitable for heating or cooling applications.

Write for Bulletin J-180

JORDAN CORPORATION

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NOVEMBER 26-30 • NEW YORK CITY COLISEUM • BOOTHS 362 & 364

B.F.Goodrich

How to handle sticky chemicals without damage to conveyor

THAT belt carries triple superphosphate, a hot, sticky, abrasive chemical that's made into fertilizer. Handling the stuff with a regular conveyor used to be a terrific problem. Sticky particles would cling to the belt, build up into gummy layers, clog the return idlers, damaging the belt cover.

Then a B. F. Goodrich distributor recommended something quite different in conveyors—the B. F. Goodrich "turnover" belt system. Here's how it works. As the material is dumped off the end of the moving belt, the belt makes a 180° turn, (as shown in the picture), runs empty along the return idlers, then makes another one-half turn before receiving the next load.

Only the clean side of the belt touches the idlers, so there's no chance for sticky materials to build up on them. Danger of belt damage is reduced because lumps of materials cannot be trapped between the belt and pulleys. At the chemical company shown in the picture, engineers predict they'll get three times more service from the belt on the "turnover" system.

If you have an operation where sticky, corrosive materials must be moved from place to place, the B. F. Goodrich "turnover" conveyor system may be the answer. Let a B. F. Goodrich distributor give you full details and show you how easy it is to convert a conventional conveyor into the turnover type. *B. F. Goodrich Industrial Products Company, Dept. M-743, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS

KELLEY

Pioneers in HOMOGENEOUS LEAD BONDING

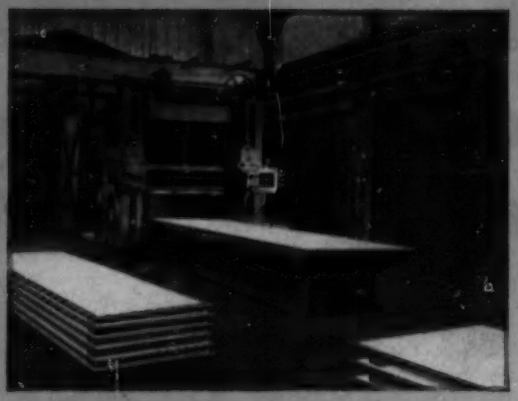
First Again with a "NEW MECHANICAL"* Bonding Process

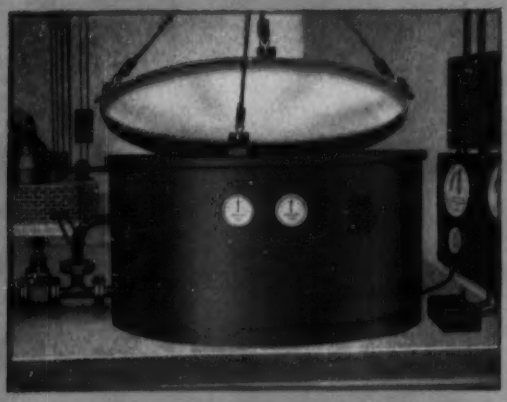
*Our newly developed "mechanical" process for applying **Homogeneous Lead Bondings** affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.

Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.

To insure uniform overall thickness of the Homogeneous Lead Bondings and eliminate the human errors occurring in other methods, lead is applied "oversize" to flat sheet plates and then planed to required thickness. In addition, this operation affords considerable savings in time over the general "Hand Scraping" method.





Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

KELLEY Custom-Built for the Processing Industries

TANKS · LEAD COILS · LEAD & LEAD LINED VALVES
SHEET LEAD LININGS · CASTINGS & FITTINGS

LEAD PROTECTION FOR RADIATION SHIELDING

O. G. KELLEY & CO.

ENGINEERS DESIGNERS FABRICATORS

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NOW A UNIQUE MULTI-PURPOSE CHECK VALVE

SILENT • SEATLESS • LOW PRESSURE DROP

Technocheck©-MP

OUTPERFORMS • OUTWEARS OTHER VALVES • COSTS LESS TO MAINTAIN

Technocheck-MP is a highly efficient check valve that has a wide range of industrial applications. Its unique design eliminates the need for valve seats and permits use in low or high pressure service. Tight sealing, low pressure drop across valve and long life with low upkeep are Technocheck-MP characteristics. Valves are produced in numerous metals and alloys as well as in polyvinyl chloride for use in PVC piping systems. They are made in standard or custom designs, and in threaded or flanged ends.

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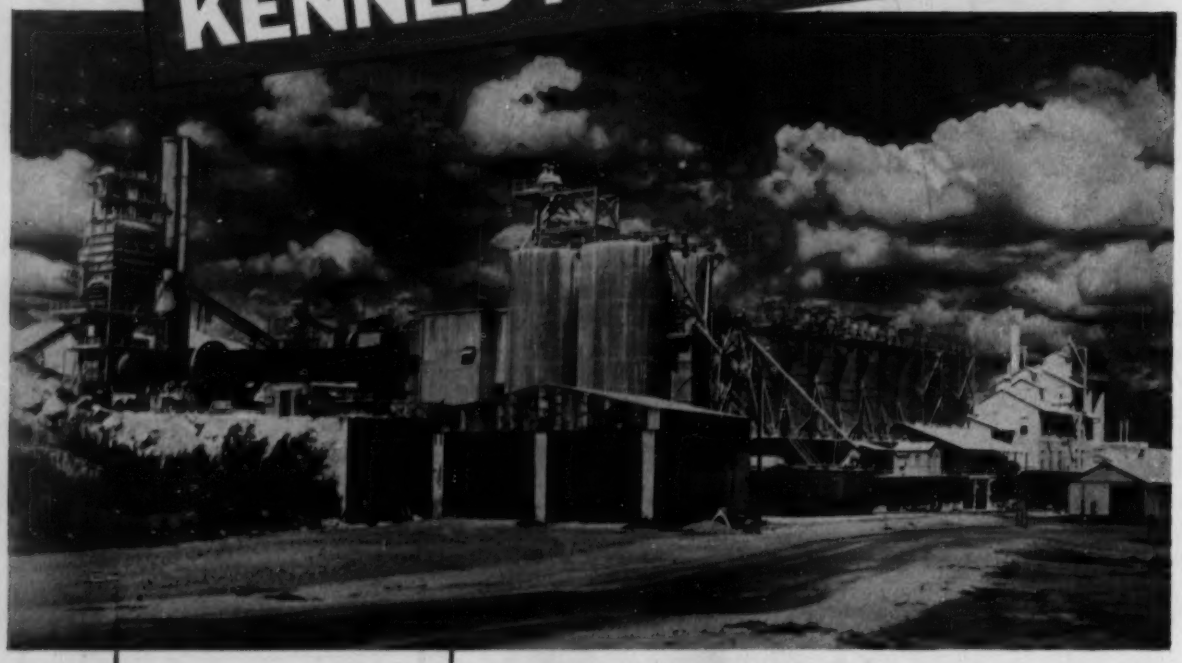
Techno Corporation
16 West 5th Street, Erie, Pa.

PEAK CAPACITY

with

KENNEDY EQUIPMENT



NEW BRAUNFELS, TEXAS,
LIME PLANT
UNITED STATES GYPSUM
COMPANY

General View of Plant Showing KVS 10′ x 150′ Kiln with Preheater Internal Recuperator and Preheater

KENNEDY PRODUCTS

- Gyratory Crushers
- Swing Jaw Crushers
- Tube Mills
- Ball & Rod Mills
- Vibrating Screens
- Rock Feeders
- Air Swept Tube Mills
- Rotary Kilns
- Coolers, Dryers
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- Belts, Conveyors
- Pneumatic Transport Systems
- Asbestos Plants
- Complete Lime Plants
- Complete Cement Plants
- Steam Generators
- Complete Aggregate Processing Plants
- Waste Heat Boilers
- Pulverized Coal Firing Systems

Send for bulletin describing KVS Machinery and Equipment

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MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK, N. Y. • FACTORY: DANVILLE, PA.

OF LIME PER DAY

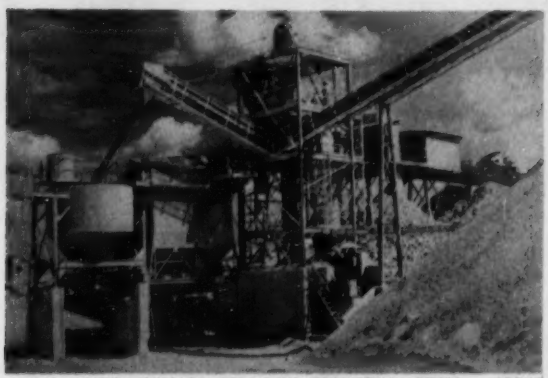
...for New Braunfels, Texas plant of United States Gypsum Company

LIME PLANT PRODUCTION BEYOND RATED CAPACITY

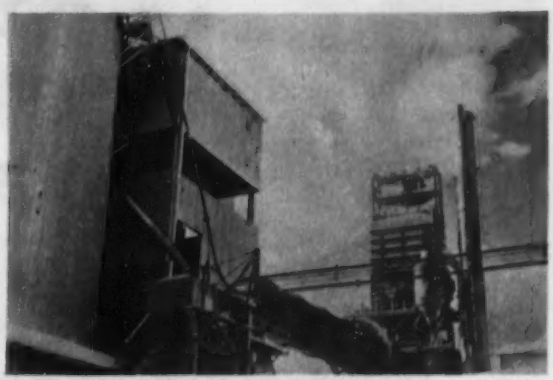
One of America's largest lime producers, United States Gypsum Company chose KVS design and equipment for their new plant at New Braunfels, Texas.

Machinery and equipment designed and furnished by KVS includes crushers, screens, conveyors, kilns, preheaters, deheaters. The installation also provides the latest automatic controls and special equipment that permits high temperature "aging lime" — important in achieving highest quality. Also, storage capacity at this plant has been almost tripled.

Whether your plant is large or small, old or new, Kennedy has the machinery and equipment for better products at lower cost. Let us prove . . . with operating facts . . . why KVS machinery is your best buy. Engineering consultation, anywhere, any time.



UNITED STATES GYPSUM CO., NEW BRAUNFELS, TEXAS — STONE PREPARATION PLANT COMPRISING KENNEDY 37½ S GEARLESS CRUSHER, KENNEDY AAA VIBRATING SCREEN AND KENNEDY BELT CONVEYORS



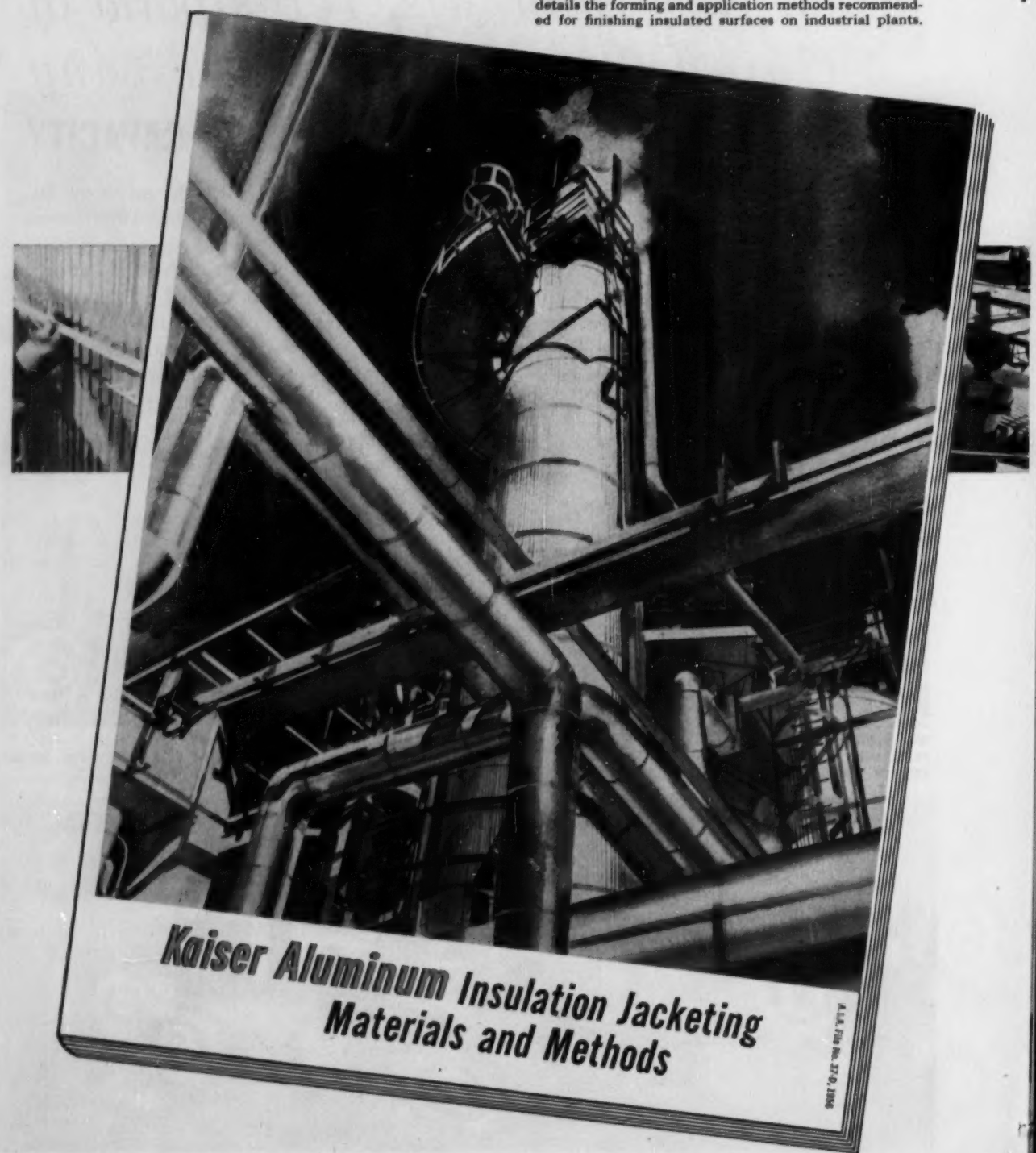
UNITED STATES GYPSUM CO., NEW BRAUNFELS, TEXAS — CLOSE-UP VIEW SHOWING INSTALLATION DETAILS OF KVS 10′ x 150′ ROTARY KILN, PREHEATER, RECUPERATOR AND DEHEATER

UNITED STATES GYPSUM CO., NEW BRAUNFELS, TEXAS — OVERALL VIEW OF STOCKPILE SHOWING OPERATION AND ARRANGEMENT OF CONVEYORS

NOW... NEW MANUAL

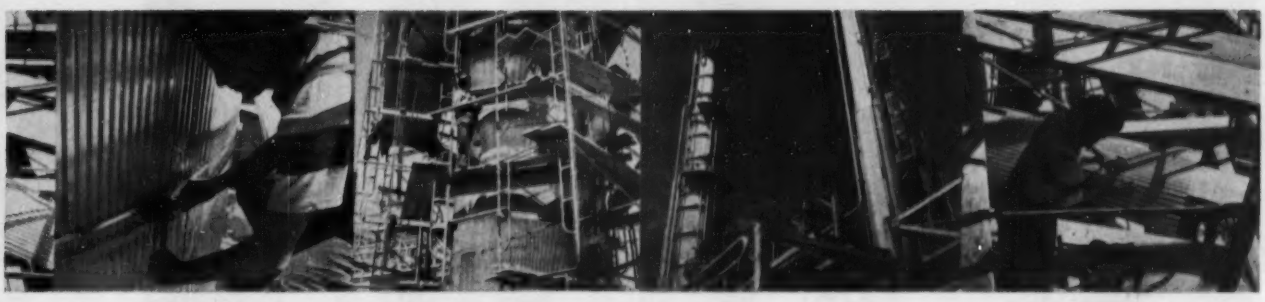
40 PAGES—FULLY ILLUSTRATED

Thoroughly describes aluminum jacketing materials... details the forming and application methods recommended for finishing insulated surfaces on industrial plants.



SHOWS YOU HOW TO GET

✓ Complete Insulation Jacketing
✓ Longer Jacketing Life
✓ Improved Appearance
✓ Lower Cost



Plant designers, contractors and owners can now take advantage of newly-developed methods for getting more complete coverage of insulation with aluminum jacketing.

This new Kaiser Aluminum manual makes available —for the first time—*complete information on the subject of aluminum jacketing.*

Emphasizes Complete Coverage

Besides showing methods for jacketing tanks, vessels and straight runs of piping, the manual shows how to jacket fittings and heads—elbows, T's, valves, flanges, reducers, branch connections, expansion couplings, tank roofs, outlets and flat, dished and conical heads.

And because these methods include adaptations of the construction industry's efficient "dry wall" techniques, they give you these other important advantages: faster, safer application, lower costs, neater installations that require less cleanup.

On-the-job Techniques Illustrated

Photographs and tables throughout show typical examples of how Kaiser Aluminum is applied in actual industry situations. Drawings and diagrams provide details of expansion joints, pipe jacketing, flashings, insulation and jacketing support arrangements for vertical walls and for storage tank roofs.

Snap Jacket Introduced

The manual introduces *snap jacketing*—refinements of proven techniques developed from Kaiser Aluminum's "idea partnership" with customers. Using these new techniques, one man working alone can quickly apply weather-tight jackets to piping.

Send the coupon today and get your free copy of this valuable manual. And for immediate assistance on any jacketing requirements, call the Kaiser Aluminum sales office listed in your telephone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum

materials for the process industries

Send your coupon today!

See "THE KAISER ALUMINUM HOUR," Alternate Tuesdays, NBC Network. Consult your local TV listing.

KAISER ALUMINUM & CHEMICAL SALES, INC.
Process Industries Department, Room 71113
1924 Broadway, Oakland 12, California

Please send my copy of your new manual "Kaiser Aluminum Insulation Jacketing Materials and Methods." I understand there is no obligation.

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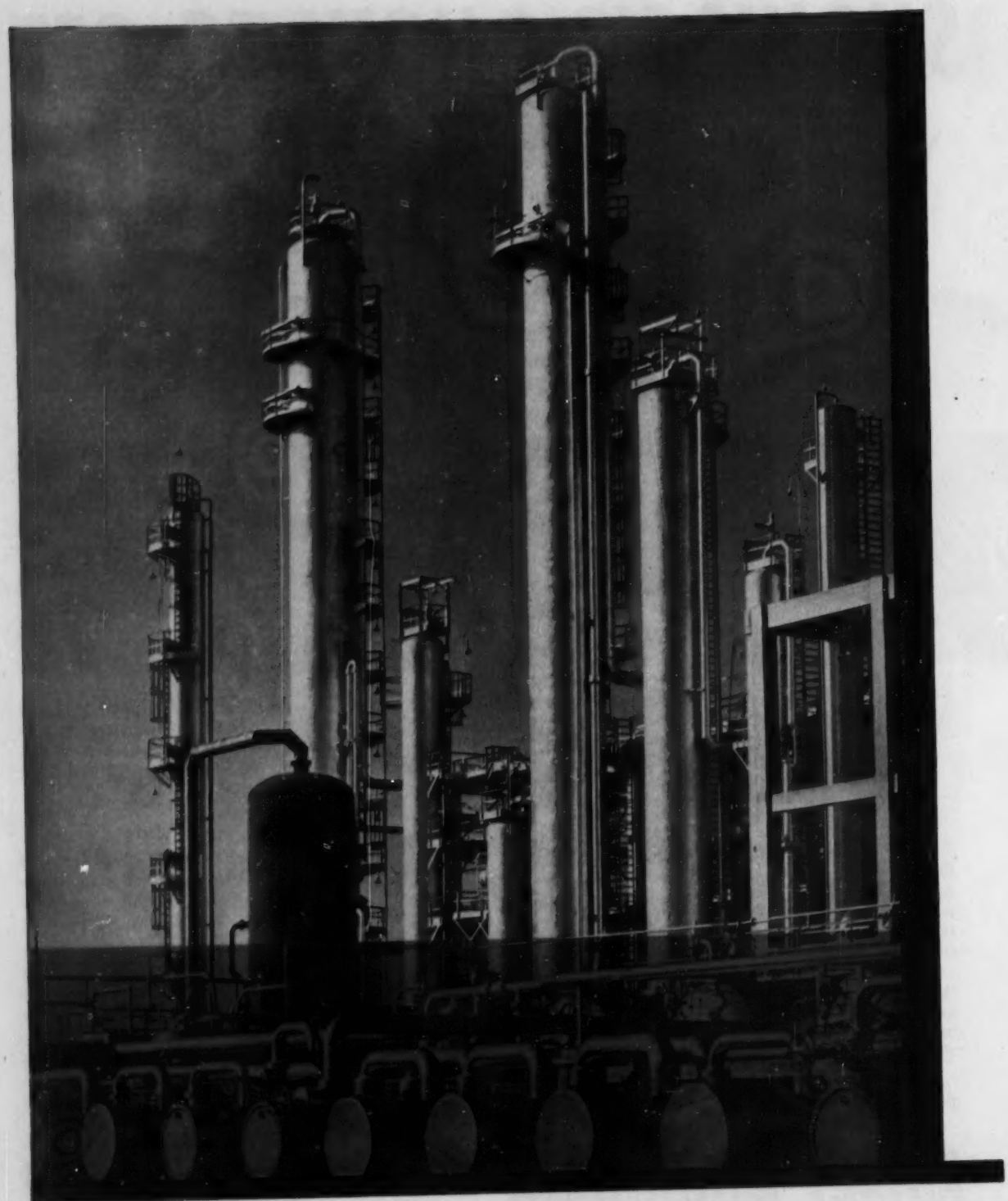
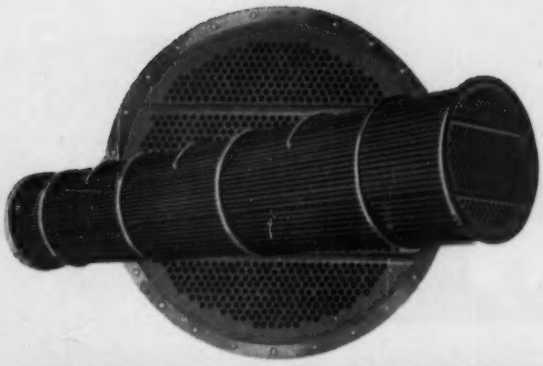
TITLE_____ COMPANY_____

ADDRESS_____

CITY_____ STATE_____



FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!



For dependable "on-stream" performance . . .
retube your exchangers with

PHELPS DODGE HEAT EXCHANGER TUBES!

Wide selection of copper-base alloys for every type of application—including bi-metal combinations.

Complete warehouse stocks maintained at Houston, Texas; Tulsa, Okla.; Los Angeles, Cal.; Chicago, Ill.; and Bayway, N. J.

Expert assistance in solving your tube corrosion problems.

Specify Phelps Dodge . . . One of the largest suppliers of tubes to manufacturers of heat exchangers!

PHELPS DODGE COPPER PRODUCTS CORPORATION

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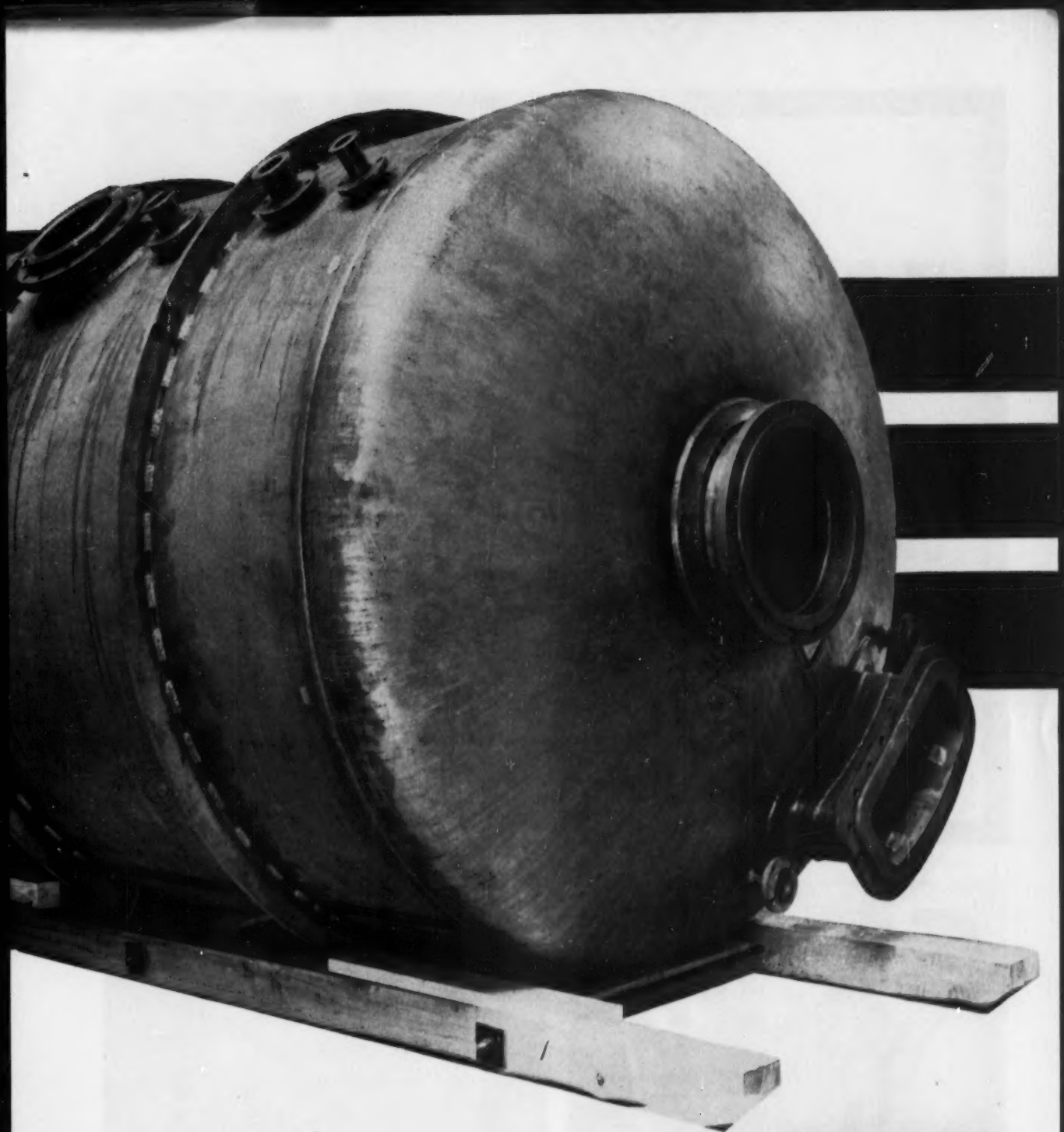
BRIGHTON BUILDS THE BIG ONES...

In unusual combinations of metals! This 5,000 gallon pressure vessel uses ⅜-inch copper-silicon. The alloy was chosen for its increased resistance to corrosion, extra long wear. The vessel is 8 feet in diameter and 15 feet long. Maximum working pressure is twenty pounds or full vacuum. Welding by shielded arc process to reduce oxidation.

Besides unusual alloys like copper-silicon, Brighton metalsmiths are skilled in working all standard types of metals — stainless steel, copper, bronze, aluminum, nickel and monel metal.

We build with precision to your specifications, chemical process equipment of virtually any size — pilot models to full scale. Typical jobs include: reactors, fractionating columns, heat exchangers, pressure vessels, agitators, kettles, tanks, coils, evaporators. You can be sure of a prompt estimate on your fabrication work. Write today for complete information.

Have Brighton bid your big ones!

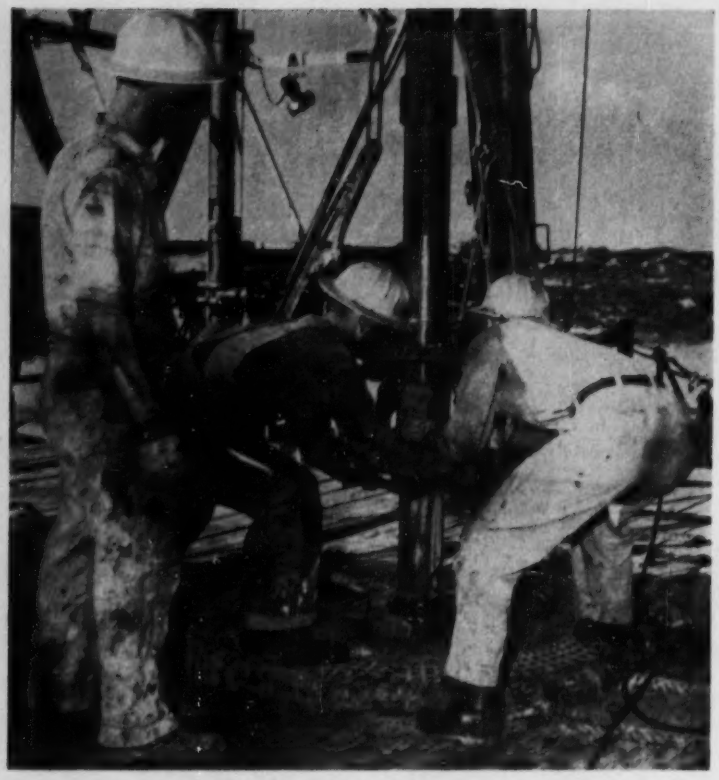


BRIGHTON CORPORATION

822 State Avenue, Cincinnati 4, Ohio

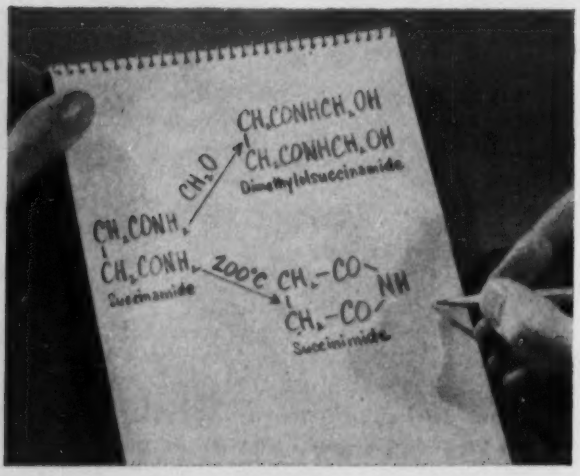
Process Equipment for the Chemical Industries since 1914

Life on the Chemical Newsfront



FIELD TESTS OF CYPAN® Drilling Mud Conditioner, a new organic water-loss control reagent, have produced excellent performance reports. As wells go deeper, a steady flow of special muds is needed to carry away cuttings, lubricate drill bits and maintain hydrostatic pressure. These muds must stand up under increasingly severe heat and contamination conditions. CYPAN stabilizes muds even at temperatures as high as 350° F. It resists contamination by salt, which otherwise would flocculate the colloidal clays present, and retards water loss so that muds maintain gel strength, lubricating and caking properties. A high molecular weight, acrylic-type polymer, CYPAN is readily soluble in water and can be added easily to mud systems. **(Industrial Chemicals Division, Dept. B)**

THERE'S A SOFTER FEEL AND BETTER DRAPE in the blouse this lady is examining, for it has been treated with Cyanamid's new CYANATEX® 3119 Softener. Both natural and synthetic fibers are lubricated and softened by this general purpose non-ionic textile finishing agent, making cloth easier to handle during processing as well as improving the appearance and "hand" of the finished garments. CYANATEX 3119 can be used alone, or in conjunction with other textile chemicals without any adverse effect on desirable characteristics such as crease retention and shrinkage control. **(Organic Chemicals Division)**

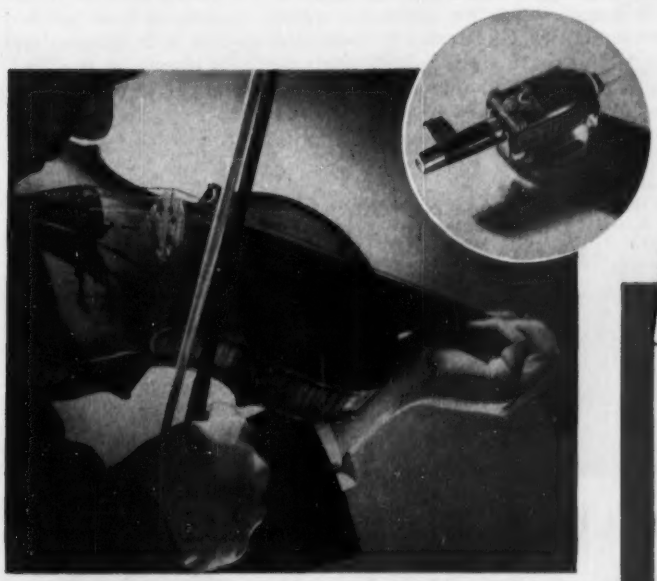


A DIAMIDE, Cyanamid's succinamide is now available for your investigation as an intermediate in which both terminal groups offer typical amide reactivity. For example, reaction with formaldehyde yields the dimethylol derivative which has possible interest in the modification of cellulose or starch. Heating produces succinimide, useful as an intermediate in the preparation of an unusual brominating agent, N-bromosuccinimide. Cyanamid's newly developed process for producing succinamide opens the way for increased acceptance of this intermediate for commercial use. **(New Product Development Department, Dept. b)**

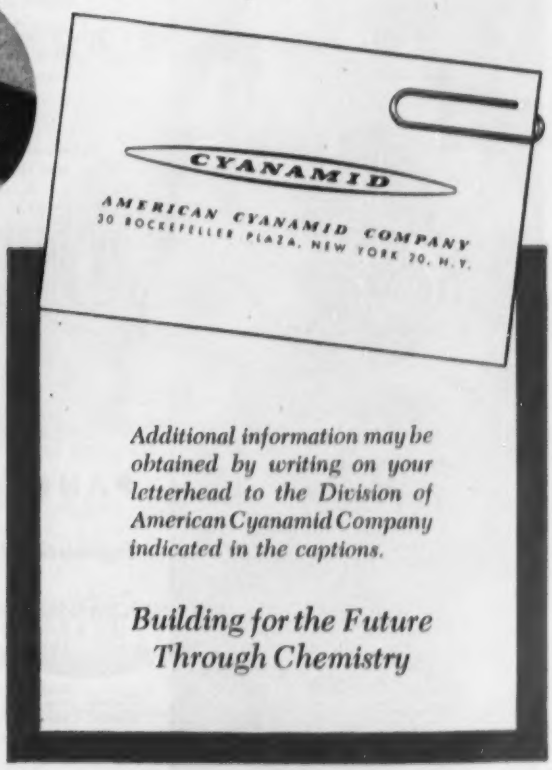
Interior Designer: Michael Greer, A.I.D.

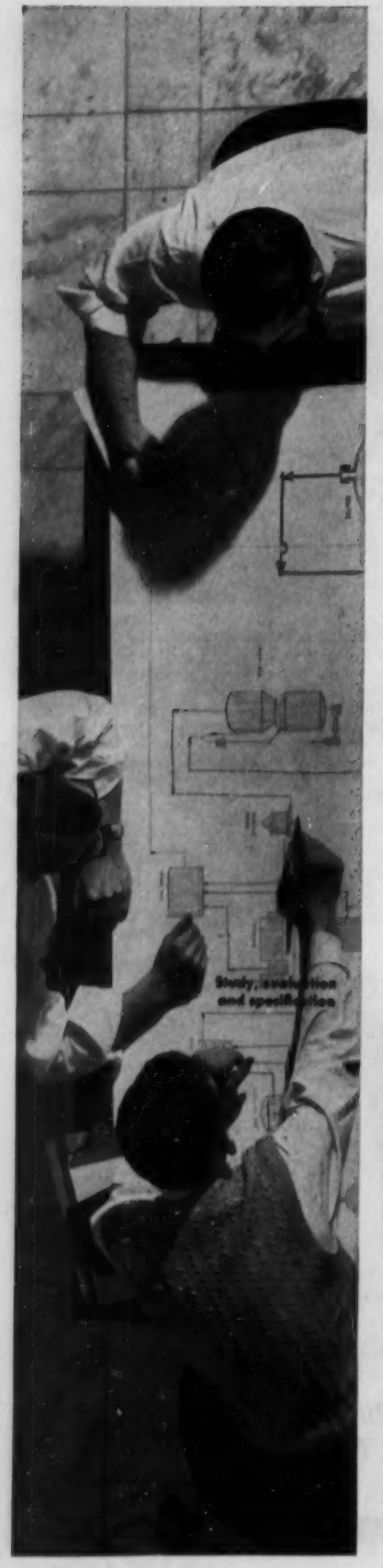
CONTINUED BEAUTY UNDERFOOT is assured in this living room, one of many rooms in a group of apartments decorated by members of the New York Chapter, American Institute of Decorators, in the Royal York Apartments, New York City. Wall-to-wall carpeting has been treated with CYANA® Soil Retardant to keep the rug new-looking between cleanings. Wool, cotton or synthetic fibers are treated at the rug mill. An invisible protective barrier is formed so that dirt particles can no longer readily adhere to the carpet fibers. Normal on-floor maintenance keeps rugs treated with CYANA in excellent appearance. **(Organic Chemicals Division)**

24 MILLION POUNDS OF ANILINE A YEAR is the goal of a new Cyanamid plant to be constructed at Willow Island, W. Va. The plant will use an entirely new process developed by Cyanamid research. For almost forty years a major supplier of aniline, Cyanamid is expanding its capacity in response to steadily increasing demand for products and intermediates dependent upon this building block of organic chemistry. Current data sheets on Aniline Oil, giving properties, specifications, uses and test methods are available on request from American Cyanamid Company. **(Organic Chemicals Division)**



HIGHER FIDELITY MUSICAL TONES are reproduced by a new phonograph designed by Pickering and Company of Oceanside, N. Y. The delicate mechanism of the Fluxvalve Pickup is sturdily housed in a unique one-piece head molded from Cyanamid's LAMINAC® Polyester Resin. The stylus is ingeniously supported in a separate LAMINAC molding, easily inserted into the head. The excellent frequency response of the Fluxvalve is protected indefinitely by the moisture-resistant and dimensional stability of LAMINAC. Another advantage is greater economy in production through the elimination of assembly problems, thanks to its integral construction. Precision molding to within .001" tolerance with LAMINAC Resins has solved critical alignment problems. **(Plastics and Resins Division)**


CYANAMID
AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
Additional information may be obtained by writing on your letterhead to the Division of American Cyanamid Company indicated in the captions.
Building for the Future Through Chemistry



Automatic control systems engineered from conception to operation by a single, responsible service

The economy and efficiency of start-to-finish engineering of automatic control systems is available from Panellit's Instrument Services Division. This staff of mechanical, electrical and chemical engineers—all with process experience—offers the broad scope of instrumentation services outlined below. Where management's own instrument and process engineers or contracting organizations are available, Instrument Services Division supplements this personnel and provides specialized experience. Division activities have included major instrumentation projects in the process, power and atomic energy industries and for engine test facilities.

Studies and evaluations of instrument requirements are made, and recommendations are submitted. If desired, detailed specifications are prepared permitting the customer to invite bids on the recommended equipment.

Equipment installation, inspection and check-out are supervised by Division instrument engineers working with factory-trained craft foremen and technicians. Typical field work includes erecting panelboards, installing field-mounted transmitters, making electrical or tubing interconnections, as well as system testing, calibration, and start-up. (Installation services are offered for instrumentation only, not for its associated process equipment.)

Field maintenance of installed instrumentation is also provided by Instrument Services Division on a contract basis.

Overall project coordination of these individual services places entire responsibility for automatic control systems in one qualified organization. Since Panellit is concerned mainly with systems and manufactures no standard instruments available elsewhere, the Division has an impartial approach in recommending system components. Your inquiry is invited.

Equipment installation and check-out

Field maintenance

Overall project coordination

PANELLIT SERVICE CORPORATION

Engineered Information Systems For Industry

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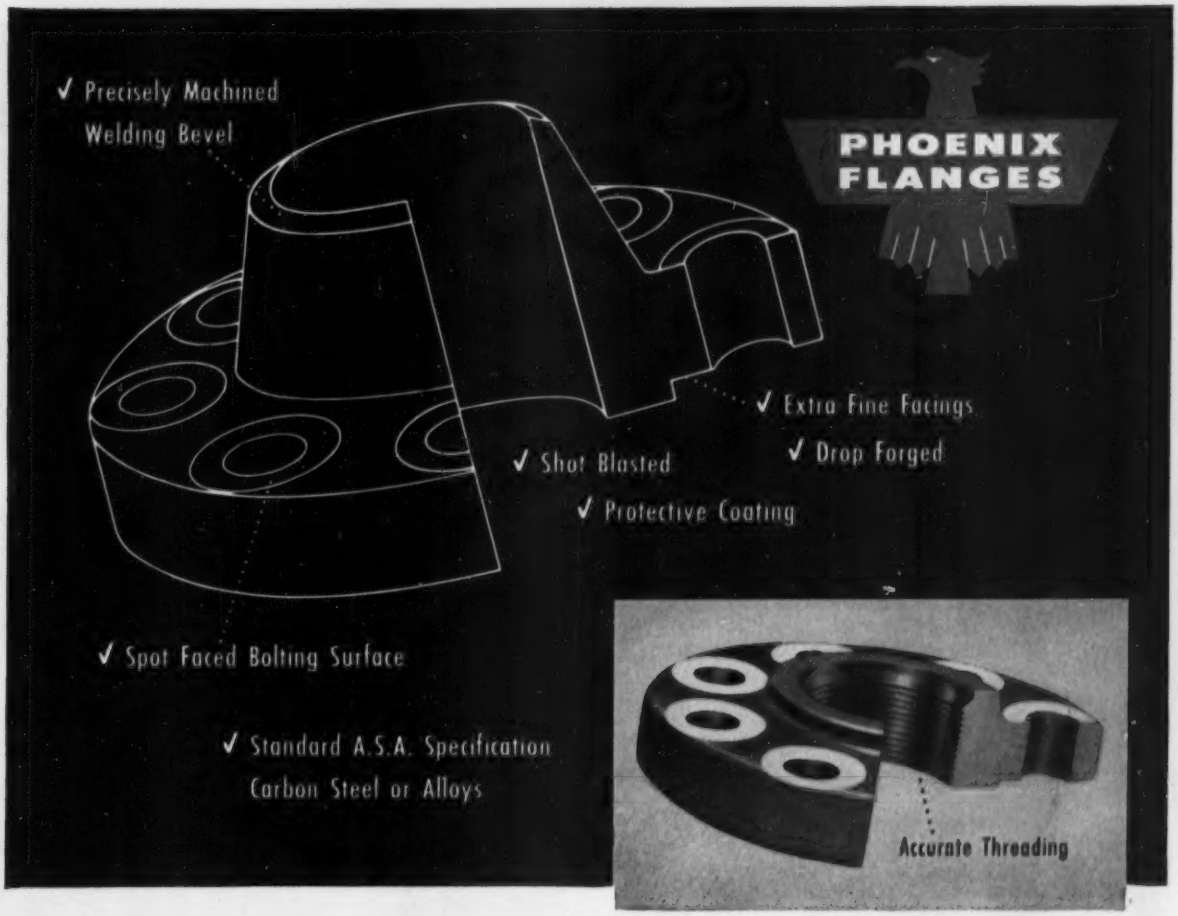


PHOENIX QUALITY STANDS OUT ALL OVER

We needn't tell you what kind of life and service you demand from the pipe flanges you buy. The important thing to know is that you are ordering flanges which will be consistently high in quality. Phoenix drop-forged flanges *always* meet the highest quality and strength specifications. No one makes a better flange!

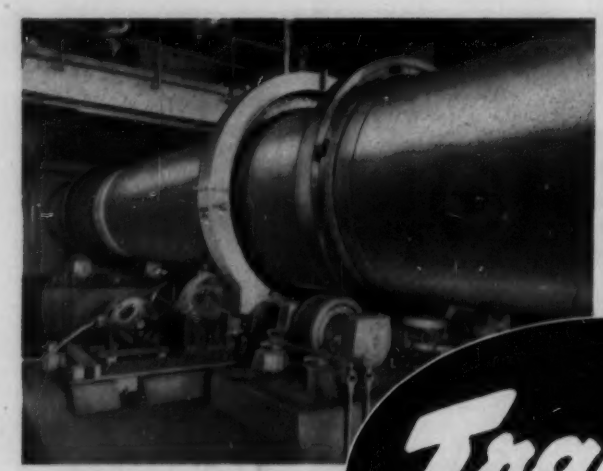
SPECIAL MACHINED FLANGES AVAILABLE
SPECIAL FACINGS • BORES • DRILLING • THREADING

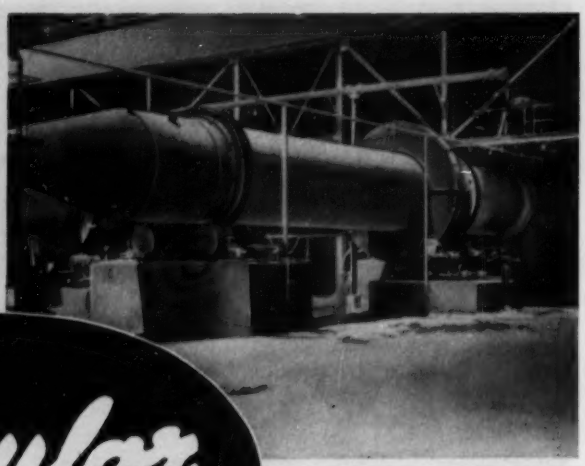
Leading Manufacturers of Pipe and Tank Flanges and Commercial Forgings

PHOENIX

FLANGE AND FORGING DIVISION
PHOENIX MANUFACTURING COMPANY
CATASAUQUA, PA. • JOLIET, ILL. • FOUNDED 1862

Integrated Manufacturing Facilities: FLANGE AND FORGING DIVISION, STEEL BAR MILL DIVISION, RUBBER PRODUCTS DIVISION AND HORSESHOE PRODUCTS DIVISION

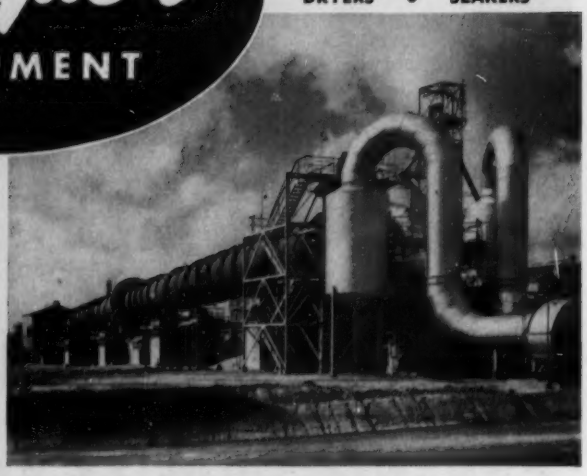




KILNS • COOLERS

Traylor EQUIPMENT

DRYERS • SLAKERS



famous throughout the Process Industries for Improving Quality and Reducing Production Costs

For over a half-century leaders in the chemical processing industry have relied on Traylor Equipment to achieve higher product quality, lower production costs and reduced maintenance bills.

In the past 14 years alone, Traylor has built an average of over 1 Rotary Kiln a month. Today, more than 175 "Traylor-Made" Rotary Kilns are engaged in the processing of over 21 different products. Custom-engineered to individual specifications, "Traylor-Made" Rotary Kilns have been built to 12′ in diameter and 450′ in length.

Traylor Dryers, Coolers and Slakers embody many of the same construction features as Traylor Rotary Kilns. They are equally famous for the production economies they achieve.

For full specifications and description of a Traylor-Made Rotary Kiln, Cooler or Slaker best suited to your particular processing operation, write for a copy of Traylor Bulletin #1115 outlining features of these machines for the processing industry.

TRAYLOR ENGINEERING & MFG. CO.

855 MILL ST., ALLENTOWN, PA.

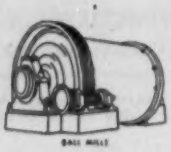
SALES OFFICES: New York · Chicago · San Francisco
CANADIAN MFRS: Canadian Vickers, Ltd., Montreal, P.Q.

A Traylor LEADS TO GREATER PROFITS

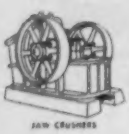
PRIMARY GYRATORY CRUSHERS

ROTARY KILNS

SECONDARY GYRATORY CRUSHERS

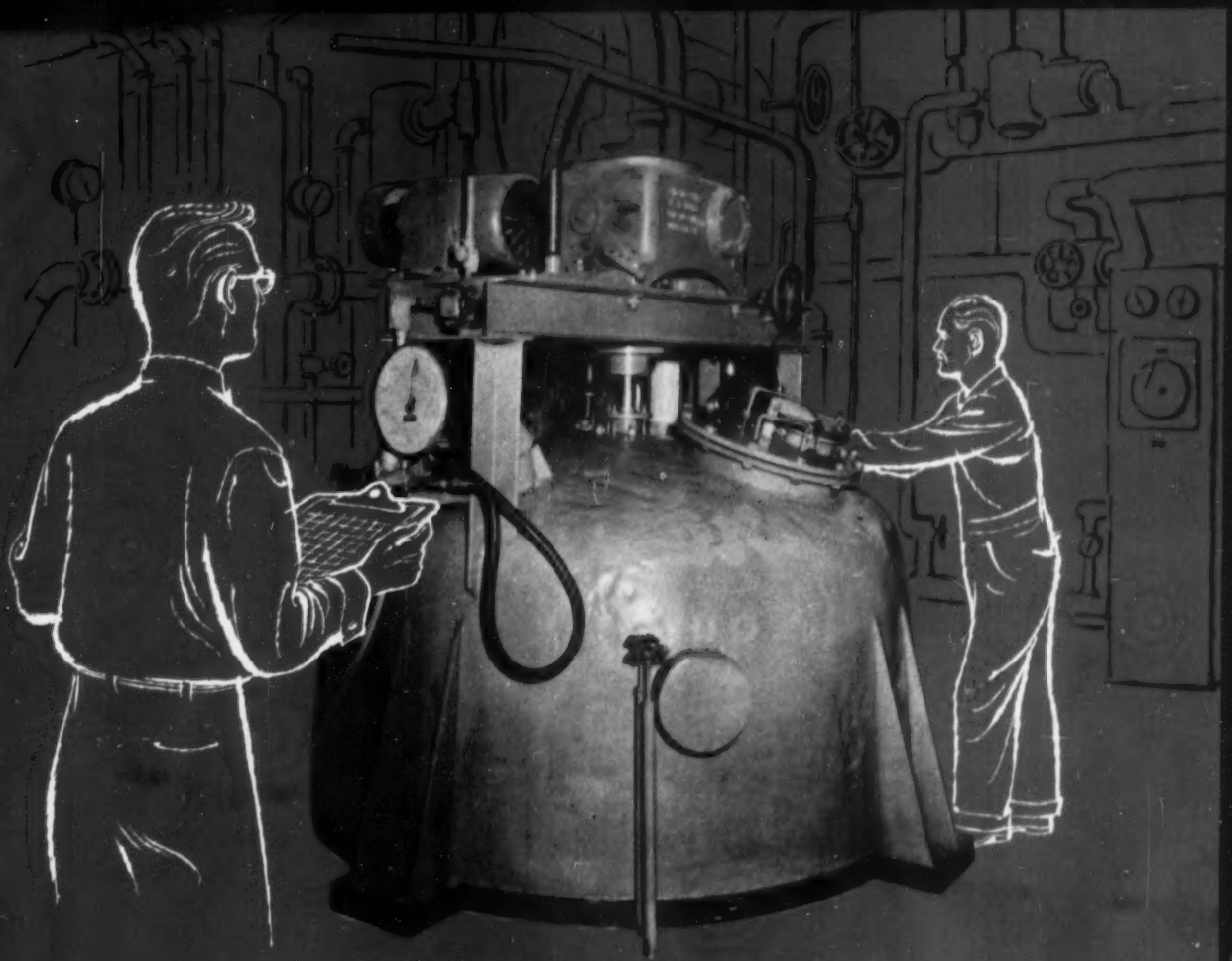


BALL MILLS



JAW CRUSHERS

APRON FEEDERS



talk to anyone

who knows **process chemicals**

he thinks of Mallinckrodt first for fine chemicals

but, he may not know that . . .

Mallinckrodt® supplies chemicals to over 200 industries

In addition to making laboratory reagents and prescription chemicals which are usually put up in small bottles, by far the major share of Mallinckrodt's business is in ***bulk chemicals*** — ton lots, carloads, millions of pounds . . . serving more than 200 industries.

Make no mistake — we're proud of the nation-wide reputation Mallinckrodt fine chemicals have earned among pharmacists and laboratory chemists.

But, if you are *not* one of the many chemists, chemical engineers or production managers who are now specifying Mallinckrodt industrial chemicals, we want to remind you that ton lots . . . carloads . . . millions of pounds of *process chemicals bear the same Mallinckrodt label guarantee* of uniform, dependable purity which will improve *your* process and cost you less.

MALLINCKRODT'S TECHNICAL KNOW-HOW AND FACILITIES HAVE SOLVED MANY PROBLEMS

Mallinckrodt Pioneered the First Commercial Production of

URANIUM OXIDE FOR THE ATOMIC ENERGY ERA

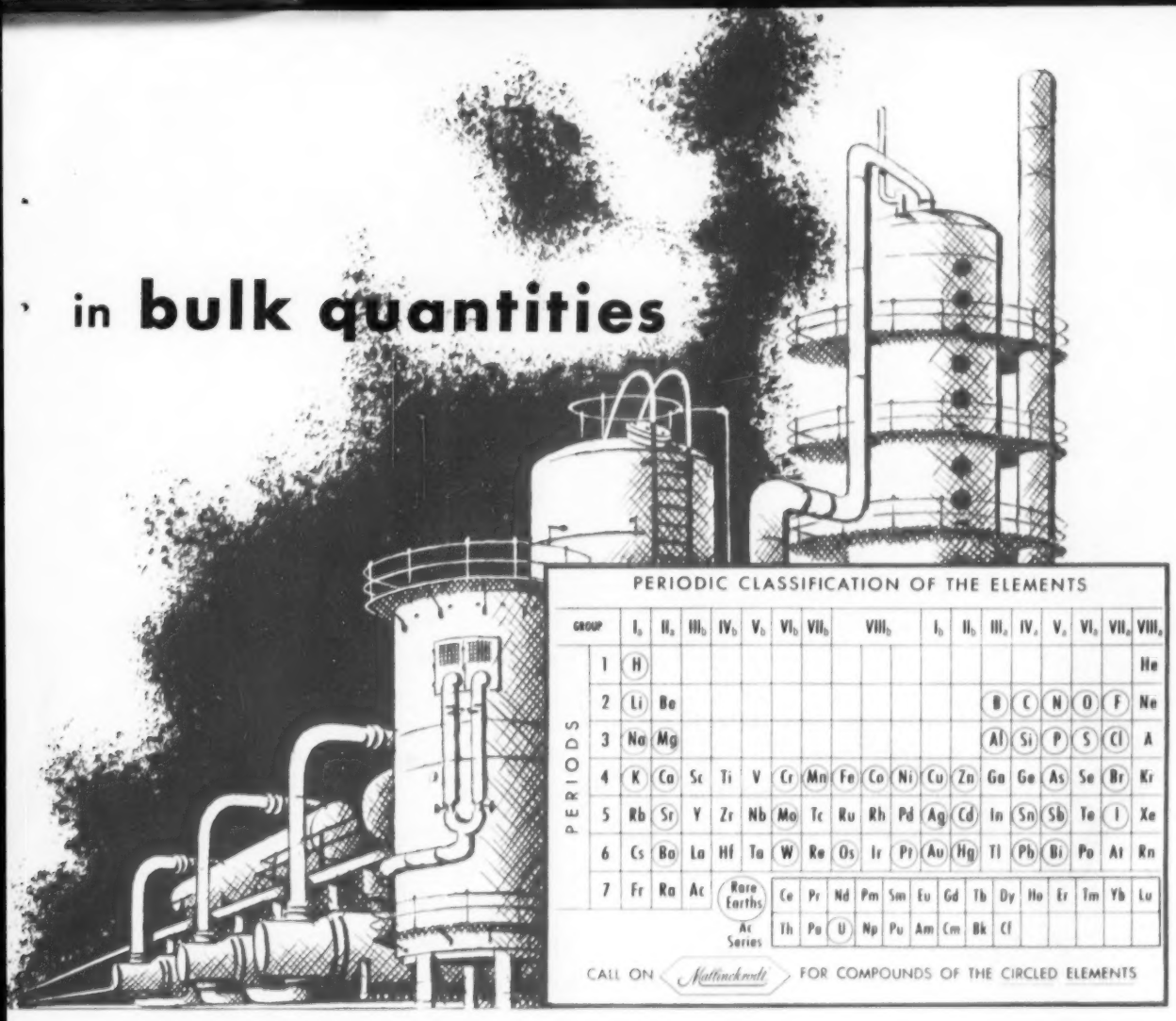
In April 1942, Mallinckrodt — because of its excellent facilities and reputation for producing pure chemicals — was assigned the job of refining crude uranium ore for the Manhattan Project. At this time it was known that ether extraction could be used to provide pure uranium oxide on a small scale, but large-scale production was necessary.

Mallinckrodt, calling on the resources of its skilled chemists, scientists and a few outside sources, in 15 weeks time designed, built and put into operation a new commercial plant and started delivery of pure uranium oxide *in quantities of one ton per day.*

Later, the Smyth report recorded: "Delivery started in July 1942 at the rate of 30 tons a month . . . it was a remarkable achievement to have developed and put into production on a scale of the order of one ton per day a process transforming grossly impure commercial oxide to oxide of a degree of purity seldom achieved even on a laboratory scale."

Since 1942, Mallinckrodt has been a major producer of uranium for the Atomic Energy Commission. Today, Mallinckrodt is more active than ever in this field. Facilities have been enlarged at the St. Louis plant and in 1957 Mallinckrodt will be operating a new $30,000,000 plant for the AEC at Weldon Spring, Missouri.

in bulk quantities



PROGRESS THROUGH CONTINUING RESEARCH

Television tube and fluorescent light manufacturers, food processors, beverage manufacturers, battery producers, paint and varnish manufacturers, paper mills, oil and grease producers, photographic and graphic arts industries are only a few of the more than 200 industries that look to Mallinckrodt for service and the right chemicals for trouble-free and profitable large-scale production.

A few of the many chemicals Mallinckrodt manufactures for American Industry:

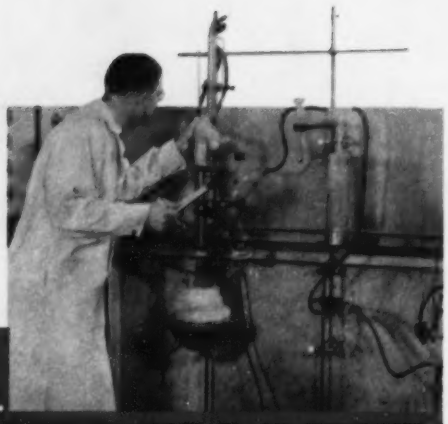
Acid Citric
Acid Gallic
Acid Pyrogallic
Acid Silicic
Acid Tannic
Alum Chrome Potassium
Aluminum Chloride
Aluminum Stearate
Ammonium Chloride
Ammonium Sulfite
Barium Acetate
Barium Carbonate
Barium Sulfide
Cadmium Carbonate
Cadmium Chloride
Cadmium Nitrate
Cadmium Sulfate
Calcium Carbonate
Calcium Chloride
Calcium Fluoride
Calcium Phosphate
Calcium Stearate
Calcium Sulfate
Chromium Sulfate
Collodion
Cupric Sulfate
Ether
Ferrous Sulfate
Iodine
Magnesium Carbonate
Magnesium Oxide
Magnesium Stearate
Manganese Carbonate
Manganese Sulfate
Mercuric Chloride
Mercuric Oxide
Mercurous Chloride
Mercury
Misch Metal
Potassium Bicarbonate
Potassium Chloride
Potassium Hydroxide
Potassium Iodide
Potassium Metabisulfate
Potassium Phosphate
Potassium Sulfate
Potassium Sulfite
Pyridylmercuric Salts
Si-O-Lite®
Sodium Bisulfite
Sodium Hydroxide
Sodium Iodide
Sodium Phosphate
Sodium Stearate
Sodium Sulfite
Strontium Chloride
Uranium
Zinc Chloride
Zinc Stearate
Zinc Sulfate

SEND COUPON ON NEXT PAGE for technical assistance

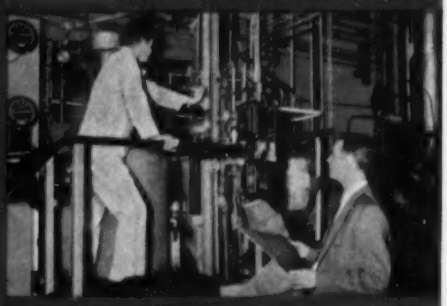
Mallinckrodt

can help you with the

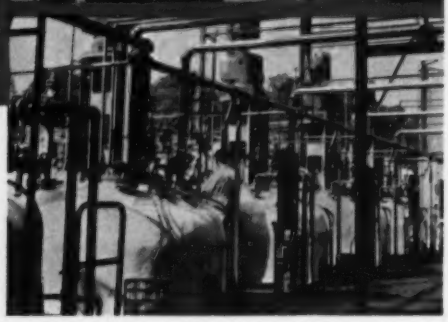
right industrial chemicals



in development.....



in pilot plant.....



in full-scale production.....

Call or write Mallinckrodt about the chemical problem you're working on.
You'll find we can be particularly helpful when
– it involves uniformity to avoid frequent equipment adjustment . . .
– physical form is critical in your application . . .
– new standards of purity are required . . .
– you want to upgrade product quality to gain a competitive edge.

Mallinckrodt®

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CHEMICALS_____

APPLICATION_____

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COMPANY_____

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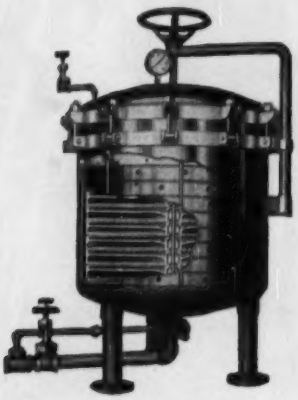
We're looking for you at... BOOTH 65

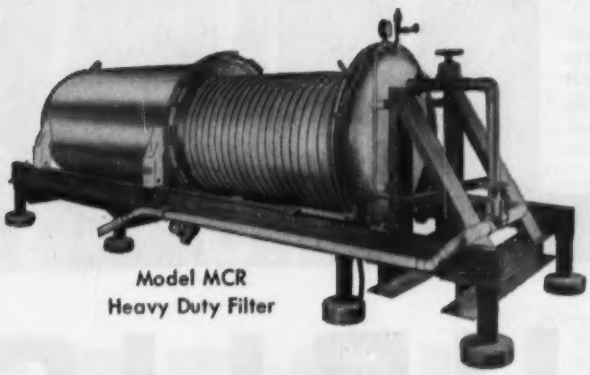
CHEMICAL SHOW . . . Cleveland . . . NOV. 27-30

Sparkler Filters

with new improved features of special interest to the chemical engineer will be displayed.



Horizontal Plate Filter



Model MCR Heavy Duty Filter

Model VR a Dual Disc Trap Filter

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MANUFACTURING CO.
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FILTRATION ENGINEERING AND MANUFACTURING FOR OVER 30 YEARS.

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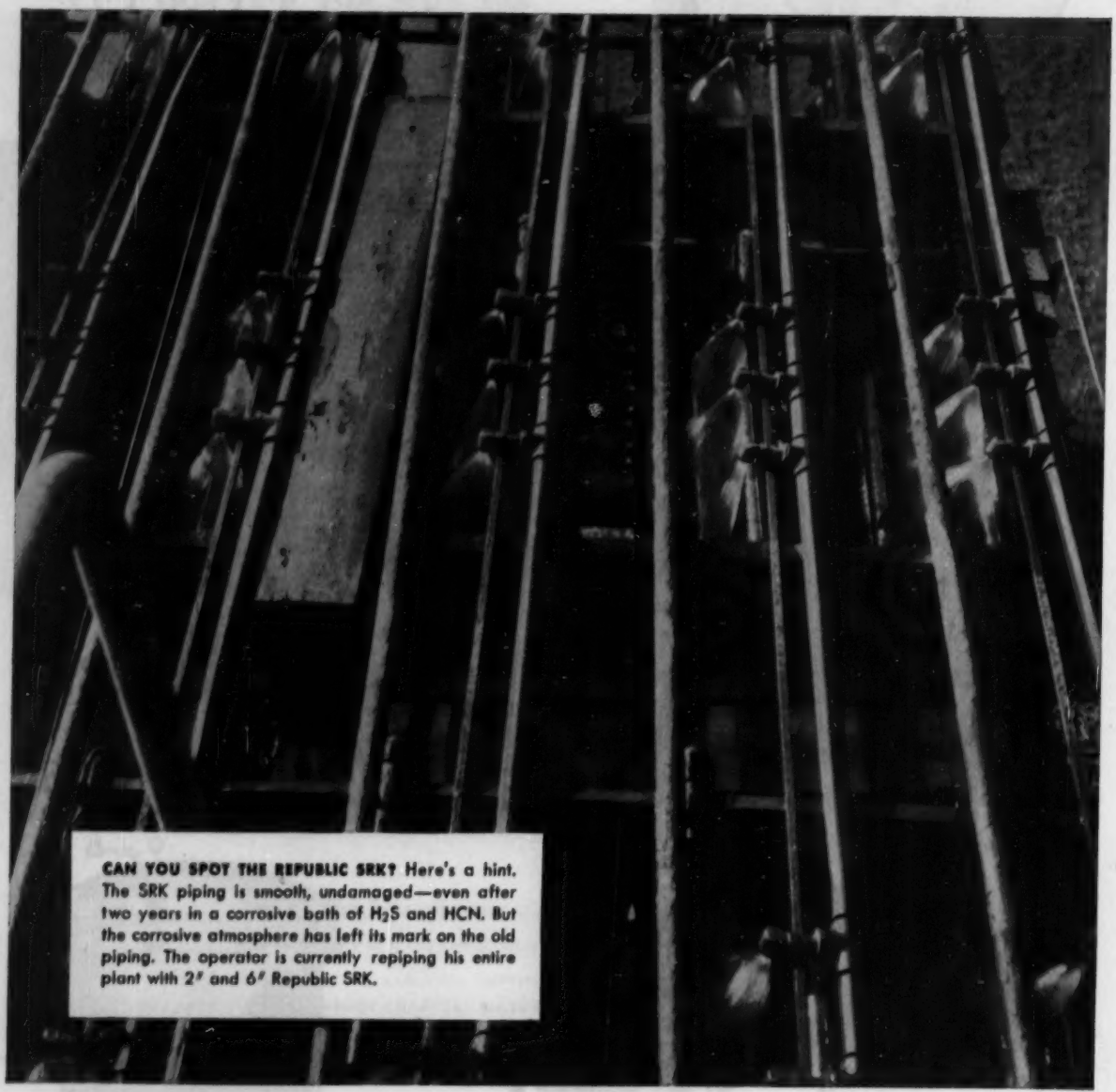
Plastic Pipes in Spray Cooler



CAN YOU SPOT THE REPUBLIC SRK? Here's a hint. The SRK piping is smooth, undamaged—even after two years in a corrosive bath of H_2S and HCN. But the corrosive atmosphere has left its mark on the old piping. The operator is currently repiping his entire plant with 2" and 6" Republic SRK.

REPUBLIC

REPUBLIC STEEL

World's Widest Range of Standard Steels

Outlast Old Piping 4 to 1

Republic SRK is still like new after rugged two-year corrosion test

The piping in that radiator-type cooler (left) is in a tough spot.

Hot coke on a nearby platform is quenched with water, enveloping the entire area in steam saturated with Hydrogen Sulphide and Hydrogen Cyanide. Every piece of equipment not resistant to the corrosive effects of acids is vulnerable.

The piping in the cooler, for example, became irreparably damaged after six months' service and had to be replaced. Each year the repair bill got bigger.

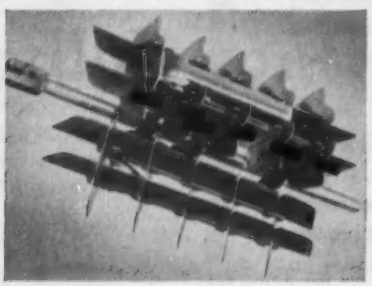
To solve this problem, the operators installed Republic SRK—the amazing, corrosion-resistant plastic pipe. Today, after two years, there are absolutely no signs of damage or wear.

Within its temperature and pressure limitations, Republic's SRK will prove ideal for many applications in the chemical and food processing industries—in both waste and process lines. It's highly resistant to a long list of corrosive liquids and gases. Being extremely tough, it will absorb terrific punishment without breaking or shattering.

Republic SRK is lightweight, easy to carry. It cuts quickly, is easily joined by simple solvent-welded sleeve-type fittings. SRK is approved by the National Sanitation Foundation as safe for carrying potable liquids.

Modern techniques and highest standards of quality control result in wall sections of uniform strength throughout each length. Republic SRK comes in three working pressures—with specific sizes for each (straight lengths only). Pipe of 150 lb. rating is available in sizes ½" through 2"; pipe of 100 lb. rating—in sizes 2" through 6"; 75 lb. rated pipe—in sizes 3", 4" and 6". Republic also supplies SRB and FE Plastic Pipes. If you have a problem, write us. We can recommend the proper pipe for the job. Send coupon for literature.

STAINLESS STEEL protects this evaporative dryer, used in the manufacture of kaolin for the coated paper industry. Equipment made from Republic ENDURO® Stainless Steel *stays* on the job, requires only minimum maintenance. ENDURO is easy to keep clean and attractive, protects purity, and safeguards other chemicals from side reactions or contamination. Republic can help you and your supplier apply ENDURO qualities and benefits efficiently and economically. Send coupon for more information.



TITANIUM offers properties, such as extremely high corrosion-resistance, that warrant its increased use in solving manufacturing and processing problems. Recently one manufacturer of ice cube trays and grids switched anodizing racks from aluminum to Republic Titanium—increased the life of the racks 100 times! Titanium was unaffected by chemical, etching, brightening and anodizing solutions. An expensive stripping operation was also eliminated. If you have a severe service problem, write Republic.

DEKORON®-COATED E.M.T., a product of Republic's Steel & Tubes Division, is recommended where electrical wiring must be protected in corrosive atmospheres. Its tough, polyethylene coating over the galvanized finish actually provides double protection. Moistureproof joints are easily made using threadless connectors and couplings and wrapping with plastic tape. Ordinary conduit in above application formerly corroded out every five years. Republic Dekoron-Coated E.M.T. has solved this problem. Send coupon for literature.

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
Dept. C-1627
3116 East 45th Street, Cleveland 27, Ohio

Please send more information on:

- ☐ SRK Plastic Pipe
- ☐ SRB Plastic Pipe
- ☐ FE Plastic Pipe
- ☐ ENDURO Stainless Steel
- ☐ Titanium
- ☐ Dekoron-Coated E.M.T.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

MODERNIZING?

New equipment needs the right instrumentation

When you're planning to install new equipment, plan to take advantage of the full potential of modern methods of measurement and control. It's the sure way to get top value for your modernization investment . . . for the improvements in production economy, quality, and versatility possible with today's production equipment depend increasingly on control instrumentation.

Here are two important points that deserve consideration if you're planning to modernize:

1. Design for control. Instrumentation is more than a necessary appendage. It's a vital, integrated part of the process itself. *Control design goes hand in hand with process design.*

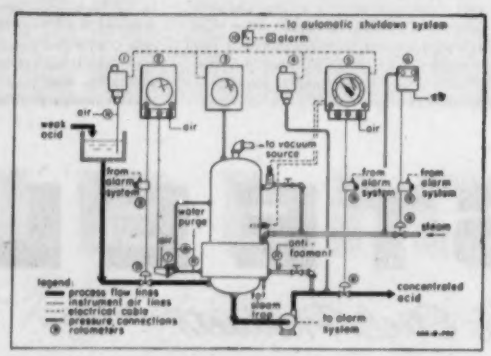
2. Get the right instrument for the job. This seems obvious—but all too often instruments may be stretched or squeezed to fit applications for which they were never intended. *Each instrument should fit its function.*

On point number 1, Honeywell's experienced application engineers will be glad to cooperate with your own staff to recommend ways in which you can obtain the full benefit of modern instrumentation. They have an extensive background not only in control technology, but also in the processing problems of various industries.

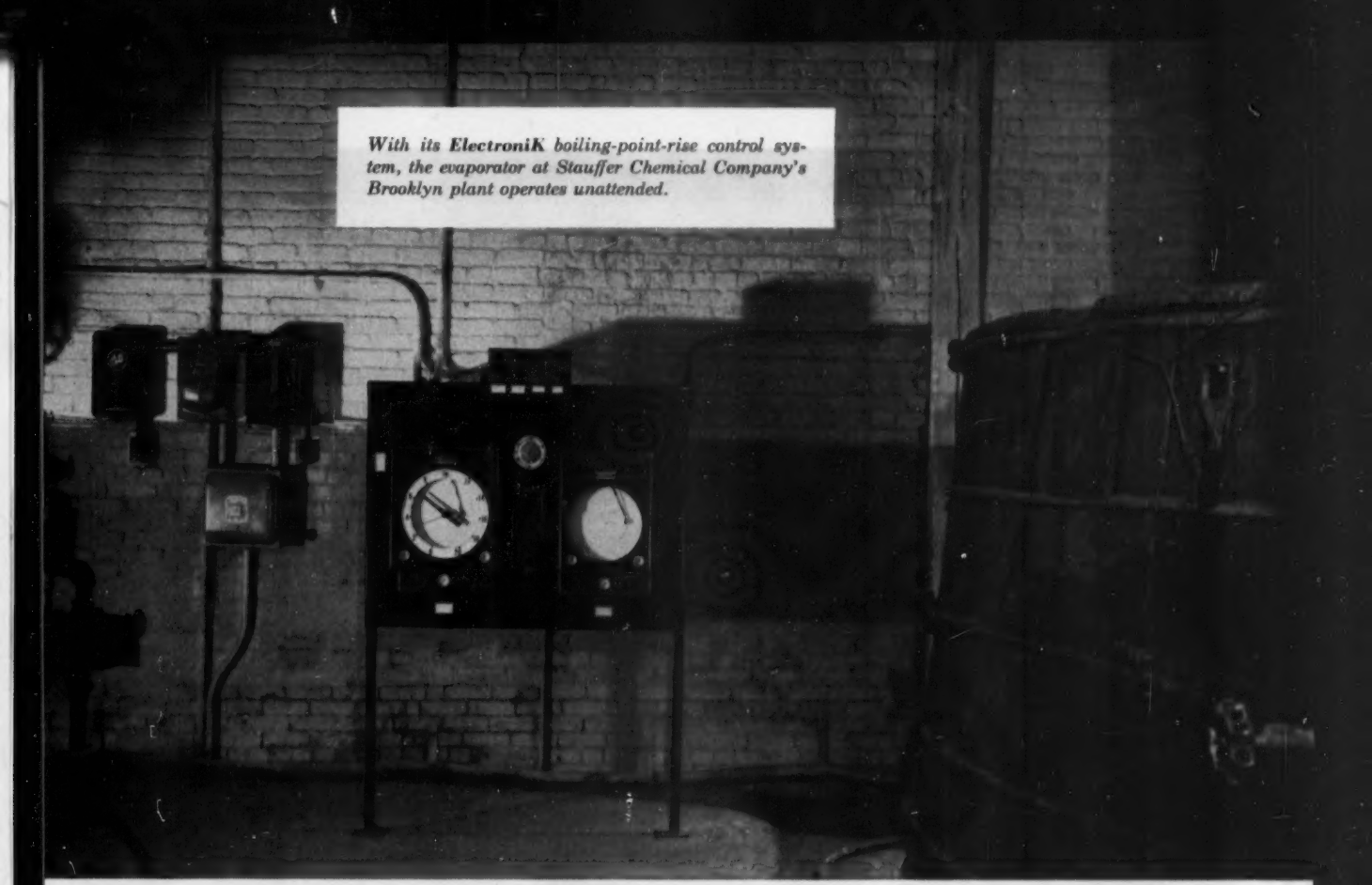
On point number 2, Honeywell offers an exceptionally wide line from which to choose. You're sure to find instrumentation with exactly the right performance . . . at the right cost . . . to fit your process. You eliminate problems of "shopping around"... and divided responsibility. This one source can fill practically all your measurement and control requirements.

A talk with your nearby Honeywell sales engineer will give you a detailed picture of what instrumentation can mean in your modernization program. Call him today . . . he's as near as your phone.

Evaporator made fully automatic...



This Honeywell boiling-point-rise control system has changed Stauffer's ill-behaved tartaric acid evaporator into a fully automatic, continuous, and efficient unit.



With its ***ElectroniK*** *boiling-point-rise control system, the evaporator at Stauffer Chemical Company's Brooklyn plant operates unattended.*

by *ElectroniK* b.p.r. control system

Operating costs cut 90%, output raised 10%, maintenance reduced 25% . . . on evaporator in Stauffer Chemical Company's Brooklyn plant.

THE evaporator used at Stauffer's plant to concentrate tartaric acid was old and ill-behaved. Productivity was low and operation expensive. Then Stauffer installed an *ElectroniK* boiling-point-rise control system that changed a manually-controlled batch operation to one that is automatic, continuous, and efficient.

Heart of the system is an *ElectroniK* resistance thermometer that uses two bulbs: one senses the temperature of the boiling liquor in the evaporator, the other that of the boiling solvent in the reference chamber. (A nine-inch-long reference chamber, designed by Honeywell, replaces a 35-foot barometric leg normally used in this application.) Since the two bulbs are differentially connected, the instrument measures the difference between the two temperatures. This is *boiling-point-rise* which is a function of product concentration and therefore a successful basis for control. The controller works with other Brown instruments that measure and control evaporator level and pressure, supply tank level, discharge pressure, and steam pressure. All instruments are interconnected to automatically shut down the evaporator if abnormal conditions develop.

The *ElectroniK* boiling-point-rise control system has made the Stauffer evaporator continuous, eliminating a 20-minute delay between batches and increasing production 10 percent. After startup, the evaporator operates completely unattended, cutting operating costs 90 percent. Uniform temperature that results from continuous operation has reduced scale formation on heating tubes, reducing maintenance 25 percent. Product concentration is consistently controlled within 0.003 specific gravity units, or ¼ of 1 percent.

Instrumentation by Honeywell, the most economical approach to modernization, may well be the answer to your own processing problem. Your nearest Honeywell sales engineer will be glad to discuss your particular requirements. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:** Write to Honeywell for copy of the article, "Evaporator Rejuvenated" by Georgs Weber, Stauffer Chemical Company.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

• WIDENING THE HORIZONS OF

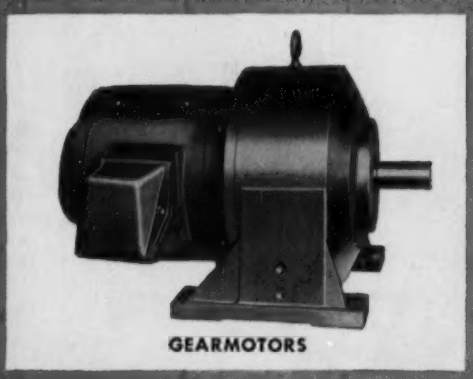
Automation is the key to greater production of more goods and services at lower cost. The Tools of Automation can be applied profitably in a countless number of individual industries.

Reliance can provide *you* with valuable engineering assistance which can help secure the advantages of automation.

Our Tools of Automation consist of electric motors, variable-speed drives and controls.

RELIANCE

TOTALLY-PROTECTED MOTORS



GEARMOTORS

REEVES MOTODRIVE

RELIANCE MOTORS ON HIGH SPEED AUTOMATIC TRANSFER MACHINES

AUTOMATION

Application of these tools ranges from a single motor to multi-motor drives for highly complex production lines, where materials are processed into finished products in one continuous operation.

The world's largest manufacturer devoted exclusively to the production of quality motors and drives is ready to help you widen the horizons of automation in your plant.

Bulletin No. A-1555-B gives further details.

A-1519

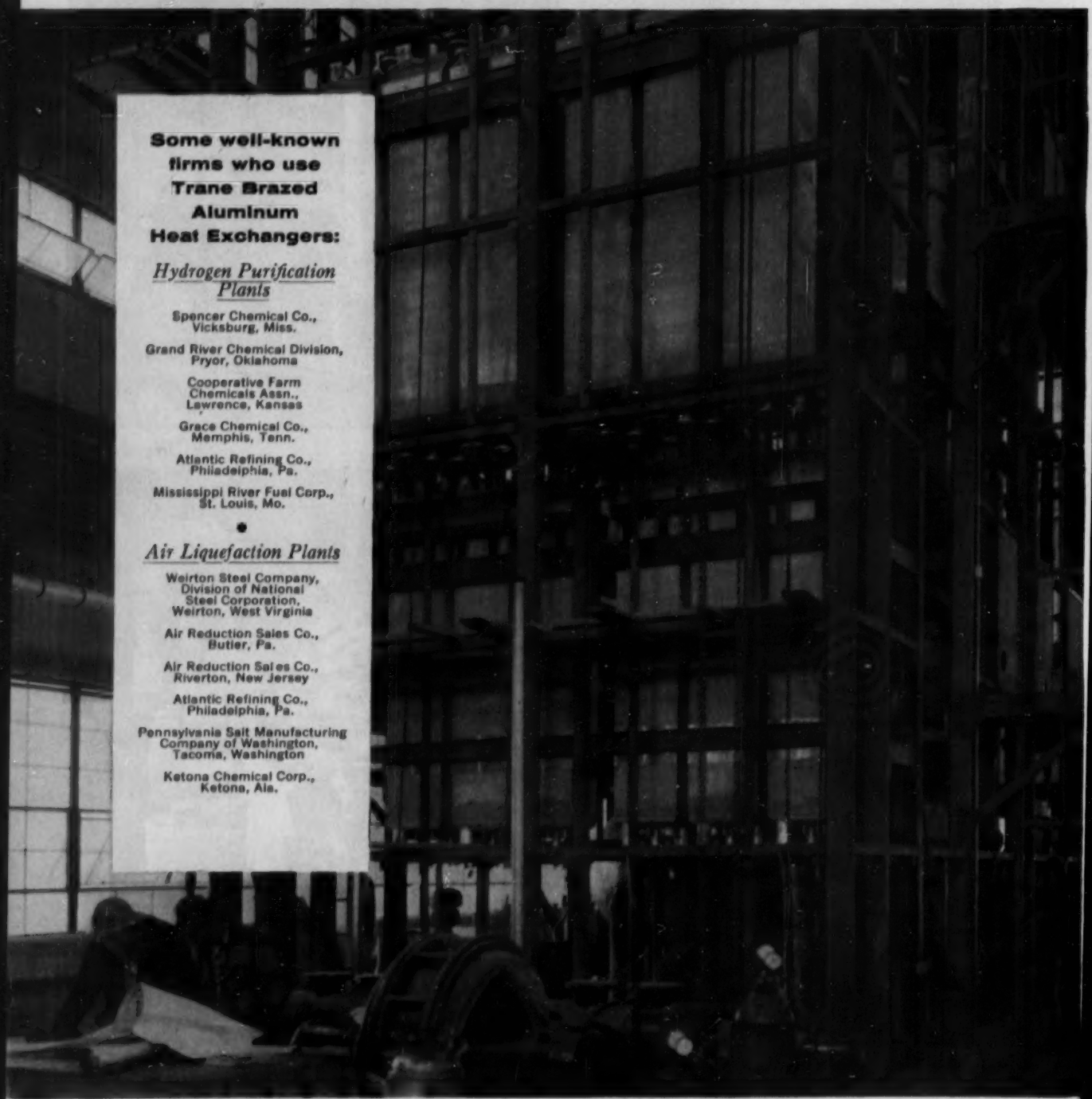
ELECTRIC AND ENGINEERING CO.

DEPT. 1311A, CLEVELAND 10, OHIO

Canadian Division: Welland, Ontario • Reeves Division: Columbus, Indiana

Sales Offices and Distributors in Principal Cities

We have designed Brazed Aluminum



Some well-known firms who use Trane Brazed Aluminum Heat Exchangers:

Hydrogen Purification Plants

Spencer Chemical Co., Vicksburg, Miss.

Grand River Chemical Division, Pryor, Oklahoma

Cooperative Farm Chemicals Assn., Lawrence, Kansas

Grace Chemical Co., Memphis, Tenn.

Atlantic Refining Co., Philadelphia, Pa.

Mississippi River Fuel Corp., St. Louis, Mo.

•

Air Liquefaction Plants

Weirton Steel Company, Division of National Steel Corporation, Weirton, West Virginia

Air Reduction Sales Co., Butler, Pa.

Air Reduction Sales Co., Riverton, New Jersey

Atlantic Refining Co., Philadelphia, Pa.

Pennsylvania Salt Manufacturing Company of Washington, Tacoma, Washington

Ketona Chemical Corp., Ketona, Ala.

The cold box at Air Reduction's Butler, Pa. plant consists of 18 TRANE Brazed Aluminum cores in six parallel columns. Each core contains 7,000 sq. ft. of heat exchange surface, weighs less than 1,000 lbs. Air at approximately 80 psig and nitrogen streams are reversed on a 10-minute cycle to clean up condensed water, ice, CO_2 and other impurities deposited in air passages. More and more air separation and ammonia plants are turning to TRANE Brazed Aluminum Heat Exchangers for efficient heat transfer.

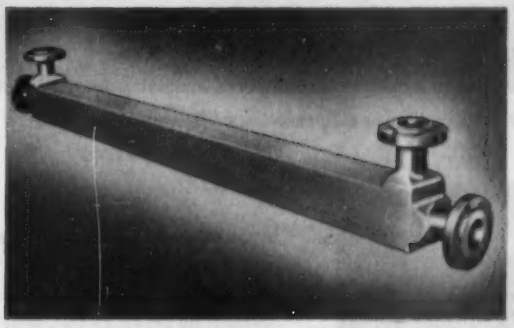
plants around Trane Heat Exchangers...

Says Air Reduction Company

"Our Butler plant, using TRANE Brazed Aluminum Heat Exchangers, went into operation in 1952. We are now increasing the capacity of this plant, enlarging our Riverton, N.J. plant and building a new plant in Chicago. These operations are designed around TRANE Brazed Aluminum Heat Exchangers. Here at Air Reduction Company it is essential that our product be *clean*—and that we get good, efficient, economical heat exchange."

Like Air Reduction Company, today's most modern air separation and ammonia plants rely on efficient TRANE Brazed Aluminum Heat Exchangers for cutting costs, maintaining highest production standards.

If you have a heat transfer problem that involves low temperatures, multi-stream exchange or close approaches, turn to TRANE! Thirty years of varied heat transfer experience is at your service. For more information, just contact your nearest TRANE Sales Office, or write TRANE, La Crosse, Wis.



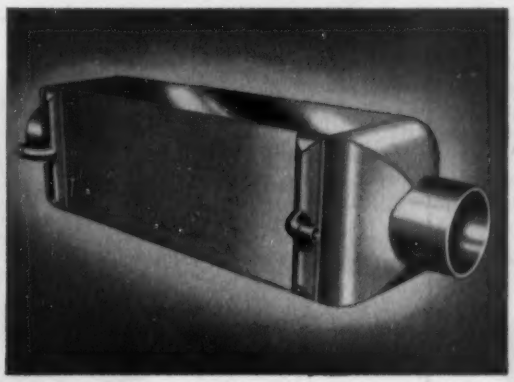
TRANE Heat Exchanger for two-stream, higher-pressure applications. Can be used for industrial and process applications requiring operating pressures up to 600 psig.

For heating, cooling, ventilating...
For <u>any</u> air condition, turn to

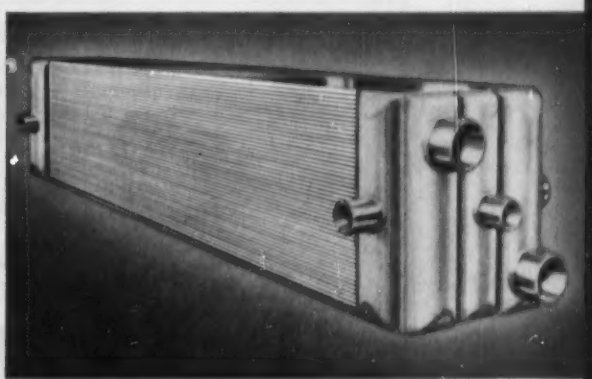
TRANE

MANUFACTURING ENGINEERS

THE TRANE COMPANY, LA CROSSE, WIS. • EASTERN MFG. DIV., SCRANTON, PA.
TRANE COMPANY OF CANADA, LTD., TORONTO • 90 U.S. AND 10 CANADIAN OFFICES



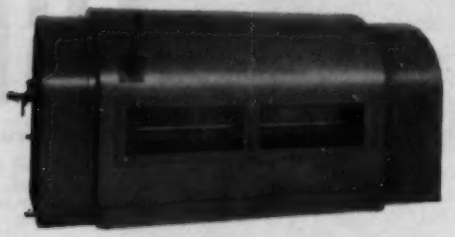
For liquid-to-gas applications, fins and passages are specially constructed to handle gas and liquids. If you have a heat transfer problem involving low temperatures or close approaches, turn to TRANE for the right equipment!



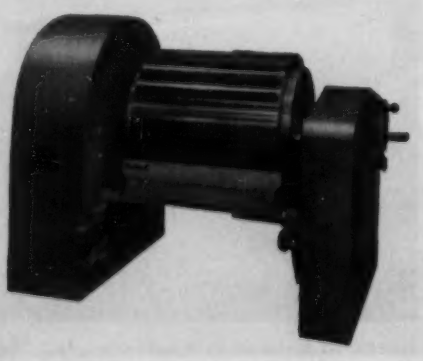
Headered for 5-stream operation, this TRANE Brazed Aluminum Heat Exchanger can handle as many as five fluids simultaneously. Units are available for either cross-flow or counter-flow operation.

"Special" features are standard in

A Stokes flaker used by Tennessee Eastman Company in the production of Tenamene 3 inhibitor.



Around-the-clock operation of this Stokes flaker produces 35 tons daily of an organic resin. Total enclosing of 2½ ft. by 6 ft. unit eliminates dust and fume hazard.



600 pounds per hour of a petroleum-base wax with a melting point of 180F is flaked on this 24" by 24" Stokes machine.

Uranium slurry is processed at a rate of 250 pounds of dried material per hour . . . with this Stokes totally enclosed, 24" by 24", single drum dryer.

that assure economy

Stokes drum dryers and flakers

STOKES drum dryers and flakers are engineered to be as modern as the new products that you'll process with them. They are precision machines, designed by specialists in chemical processing equipment. Standard features built into them, usually considered "special" in this type of equipment, make them exceptionally economical to operate . . . high in production efficiency, low in maintenance.

Count on Stokes for these design "extras"—

Rigid doctor blade arrangement.

End scrapers—provided as standard equipment.

Anti-friction roller bearings.

Lateral roll adjustment—to assure edge alignment.

Totally enclosed end frames—to protect bearings and power drive.

Six-point, edge pressured end board adjustment—to prevent plate deflection and leakage.

Amply powered, compact variable speed drive—to provide high torque.

Stable, balanced drums—to hold tolerance and shape at high or low steam pressures.

For information and specifications, write to Stokes today . . . or contact your nearest Stokes office. Call on the Stokes Advisory Service, too, for valuable help, not only in applying drum dryers and flakers, but also in correlating the operation of this equipment with other processes in your plant.

Bring your production problems to the Stokes Laboratory

For many years, Stokes has maintained a complete laboratory service for its customers. Fully equipped with both pilot and production-size equipment, this laboratory can help you to apply to your own problems the knowledge gained during more than half a century of experience. From it come recommendations for processing techniques, most effective size and type of equipment, special designs or modifications . . . to assure that you realize the full potential of the Stokes equipment that you use. Call your local Stokes office for a discussion of the problems you'd like the Stokes Laboratory to investigate.

Process Equipment Division
F. J. STOKES CORPORATION
5512 Tabor Road, Philadelphia 20, Pa.

STOKES

NOW—PRECISION-MADE

Unique Optical Comparator Assures Accurate

As the first to apply the technique of micrometric projection to the manufacture of wire screen cloth, Hewitt-Robins can now meet the most exacting specifications every time. With the use of this Optical Comparator, an unusually high degree of accuracy can be obtained because all measurements and comparisons are made on a greatly enlarged image rather than on the object itself. There is no direct contact with any part nor can there be any deformity caused from measuring pressure.

The actual wire sample is projected on a master chart with such magnification that the operator can instantly see and correct the smallest variation in the specified crimp. As a result, the crimping machine can be adjusted to three decimal places to obtain maximum uniformity of product.

This is one more special Hewitt-Robins technique for assuring you the finest in wire screen cloth for every sizing, separating or screening operation. Hewitt-Robins wire screen cloth is tougher . . . resists extreme abrasion . . . lasts longer. Every piece is tightly woven with precisely accurate openings and will provide you with higher operating efficiency and lowest cost per ton.

Hewitt-Robins screen cloth is obtainable in a wide variety of weaves in plain steel, spring steel, oil-tempered steel, stainless steel and many other alloys . . . is carried in stock in both Super and Gyraloy grades, 3/16" openings and coarser.

INDUSTRIAL DIVISIONS
PRODUCTS

INDUSTRIAL HOSE • VIBRATING CONVEYORS
CONVEYOR BELTING • CONVEYOR MACHINERY
VIBRATING SCREENS • DESIGN, MANUFACTURE, ENGINEERING AND ERECTION OF COMPLETE BULK MATERIALS HANDLING SYSTEMS
"JONES" POWER TRANSMISSION EQUIPMENT
"GLIDE RIDE" THE NEW MOVING SIDEWALK

HR HEWITT-

STAMFORD,

SCREEN CLOTH

Quality Control

New Optical Comparator for testing the crimp of wire screen cloth compares samples with master chart. Projected image has been magnified 10 times for precision comparison by D. K. Wallace, Superintendent of Hewitt-Robins Square Mesh Department.

ROBINS

CONNECTICUT

HEWITT-ROBINS VIBRATING SCREENS

Hewitt-Robins Vibrating Screens are manufactured in a variety of styles and a wide range of sizes for every need of industry.

GYREX SCREENS

General-purpose, positive-stroke, 4-bearing screen with amazing versatility of application and an unsurpassed record for stamina in service.

STYLES M AND M5 VIBREX SCREENS

Full-floating, unbalanced, pulley-type, 2-bearing screen. Offers sharp sizing of a wide variety of materials at low cost.

STYLE J VIBREX SCREENS

General-purpose screen applicable to a wide variety of screening operations. Wide range of sizes for suspended mounting.

STYLE HS HIGH-SPEED VIBREX

For fine screening operations (up to 100-mesh in some cases). Highly effective circle-throw screening action.

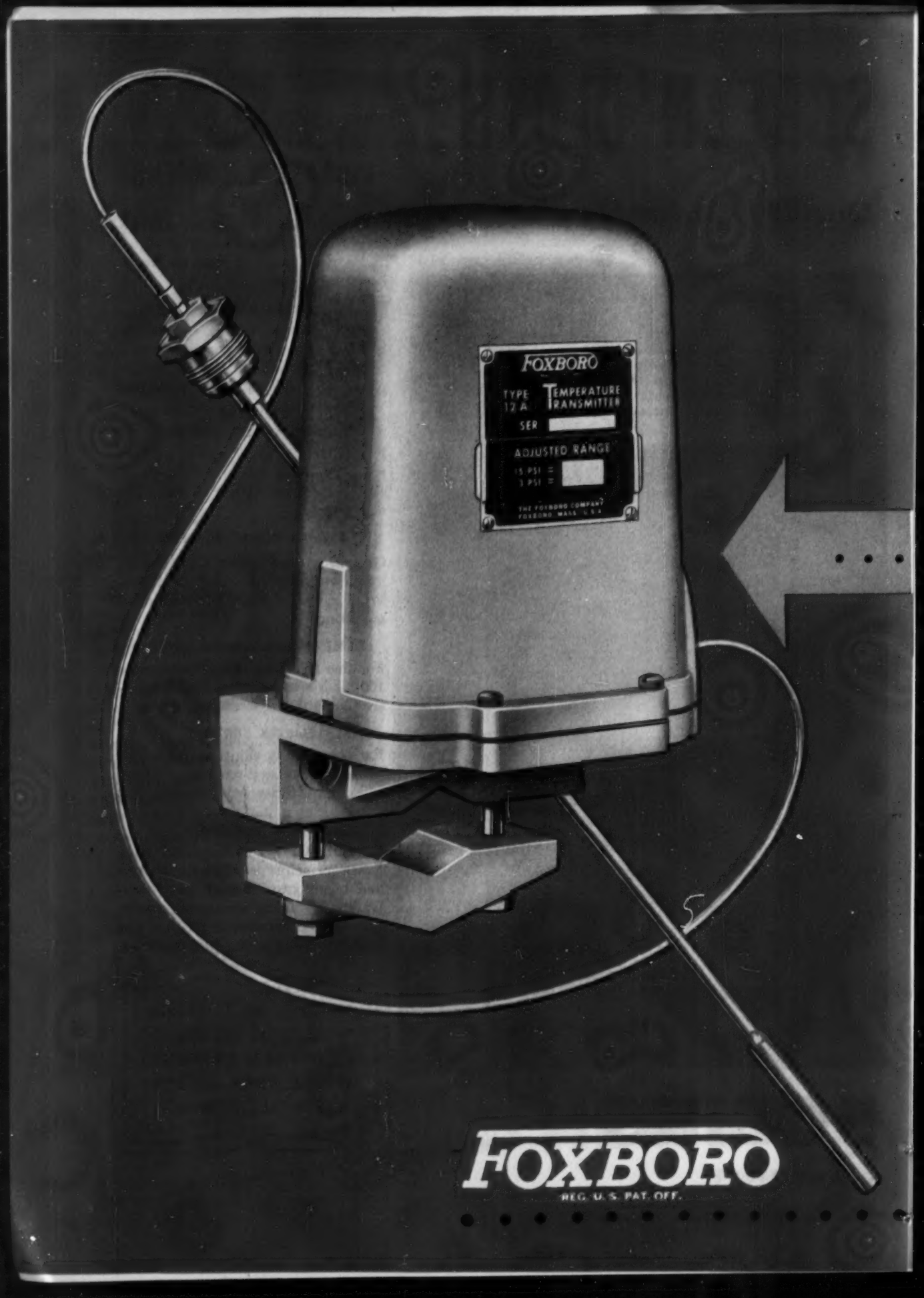
ELIPTEX SCREENS

Exclusive 3-way elliptical motion for sharpest sizing and most effective dewatering. Horizontal-operating flat screens.

HI-G SCREENS

Revolutionary new "modified resonance" principle permits larger screens and bigger capacities at less power. Unusually sharp screening action. Can be made in sizes larger than any other vibrating screen on the market.

FOR SERVICE AND INFORMATION ON BELTING AND HOSE CALL YOUR LOCAL HEWITT-ROBINS INDUSTRIAL SUPPLY DISTRIBUTOR LISTED IN THE "YELLOW PAGES"


FOXBORO
TYPE 12 A TEMPERATURE TRANSMITTER
SER
ADJUSTED RANGE
15 PSI =
3 PSI =
THE FOXBORO COMPANY
FOXBORO, MASS. U.S.A.
FOXBORO
REG. U.S. PAT. OFF.

Rugged, Versatile Temperature Transmitter Improves Remote Control

. the Foxboro M/12A (pneumatic)

There is no easier, simpler way to measure remote temperatures, *fast*, over so wide a range, with such high sustained accuracy, and at so low a cost!

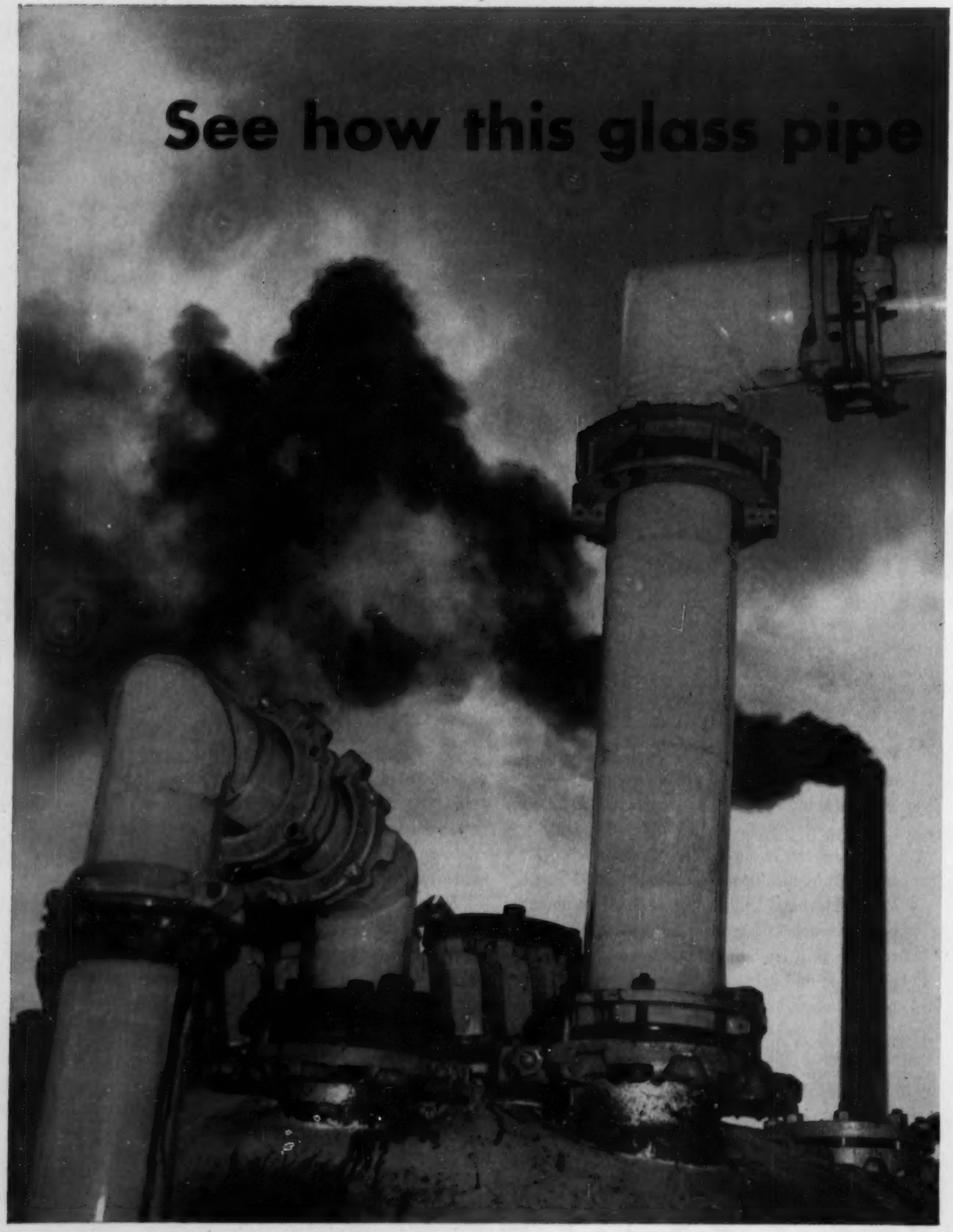
Between the limits of —100°F. and +1000°F., with operational spans of 50°, 100°, 200°, and 400°F, this rugged, highly responsive instrument performs outstandingly under the most severe conditions. It is compensated for ambient temperatures and pressure. Derivative action can be furnished for optimum performance when substantial thermal or transmission lags exist.

With its weatherproof housing and integral mounting bracket, it can be installed in any hazardous, corrosive, or outdoor location. Transmission lines are standard copper tubing, no electrical hazard, no costly capillary to run.

Write for Bulletin 13-17. It explains fully why the Foxboro M/12A Temperature Transmitter gives better performance with lower installation and maintenance cost. **The Foxboro Company, 3611Neponset Ave., Foxboro, Mass., U.S.A.**

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

• Pneumatic Temperature Transmission



PYREX pipe does a superior job handling such acids as sulphuric, hydrochloric, nitric and acetic; and such materials as chlorinated hydrocarbons, hydrogen peroxide, bromine, brines and metallic salts of all concentrations.

stands up to one of the toughest corrosives of all

This Crosby Chemical Co. case history, involving the successful handling of extreme corrosives, may help you cut corrosion in your plant.

At its DeRidder, La. plant, Crosby pipes chlorinated resins at 15″ Hg vacuum. Temperatures are 70° to 250°F.

With conditions like these, you could reasonably expect frequent pipeline replacement, high maintenance costs—and all the other usual problems you face in handling severe corrosives.

Yet Crosby's lines have been in service 3 years. Scaling is nonexistent. They've never been cleaned. Maintenance costs hardly exist. Reason: they're PYREX *brand "Double-Tough" glass pipelines.*

So well pleased are the Crosby folks with glass pipe performance, they now use it in a new plant at Picayune, Miss.

Name your corrosive

You can transfer just about any corrosive you handle today—or will handle in the future—in corrosion-proof glass pipe. Only exceptions are hydrofluoric acid and hot concentrated alkalies.

And this same chemical inertness may give you still another important reason to choose glass. *Glass pipe neither adds to nor takes from sensitive fluids.* You can end contamination with it. It puts an end to metal pickup.

What about pressure, temperature?

If you have to pipe hot fluids and fluids under pressure, this table shows how far you can go with glass pipe. It shows, too, how much tolerance you can allow for thermal shock.

When you install PYREX brand glass pipe in your plant, you'll be joining hundreds of other firms who have used it for as long as 30 years. You'll start immediately to collect the savings that come whenever you cut corrosion out of a process.

Help close by

Near you is a distributor of PYREX brand pipe. He'll be glad to help you evaluate its place in your plant. At your convenience, he'll arrange for you to see an actual installation.

For his name, and for detailed information, send us the coupon today.

How you install glass pipe—PYREX brand "Double-Tough" glass pipe is as easy as any other pipe to install, actually easier than the heavyweight pipe material you may be using now. Even if your usual pipe fitters have never seen glass pipe before, they'll be able to install it readily.

RECOMMENDED WORKING PRESSURES—TEMPERATURES

Pipe Size	Maximum Recommended Working Pressure	Maximum Sudden Temperature Differential	Maximum Operating Temperature
1″	50 p.s.i.	200° F.	450° F.
1½″	50 p.s.i.	200° F.	450° F.
2″	50 p.s.i.	200° F.	450° F.
3″	50 p.s.i.	200° F.	450° F.
4″	35 p.s.i.	175° F.	450° F.
6″	20 p.s.i.	160° F.	450° F.

No installation too complex—Inside your plant or out, long lines, manifold systems, tricky turns, or involved equipment hookups—you can get all the fittings you are most likely to need from your distributor.

CORNING GLASS WORKS
CORNING, N.Y.
Corning means research in Glass

CORNING GLASS WORKS, 111 Crystal Street, Corning, New York

Please send me more detailed information on PYREX brand "Double-Tough" glass pipe ☐; send name of nearest PYREX pipe distributor ☐.

Name..... Title.....

Company.....

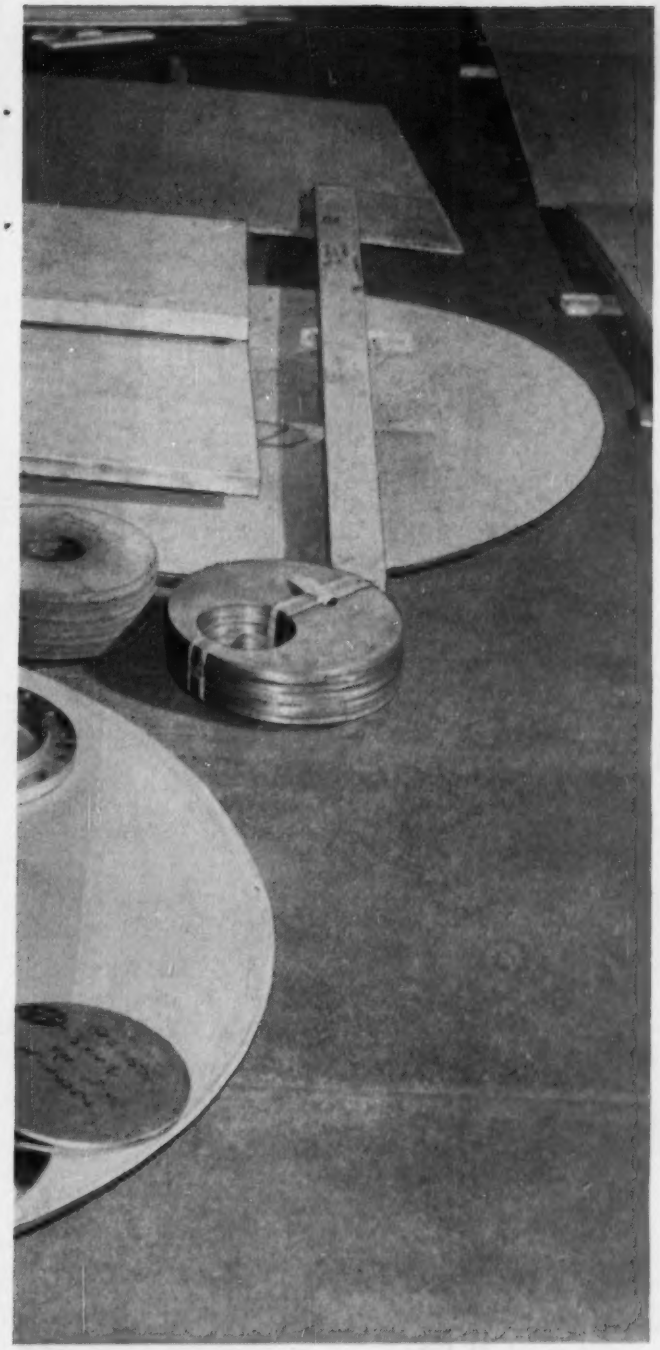
Street.....

City..... Zone..... State.....

12"x 2" Disc or 200"x 132"x 2" Plate

...Carlson is your ONE source for ALL stainless steel components

STAINLESS STEEL PLATES • PLATE PRODUCTS • HEADS • RINGS



Check your drawings and you may find that you require all of the stainless steel items shown here—plates, heads, tube sheets, discs, forgings, flanges, rings, special patterns, bars, and sheets (#1 Finish) in the heavier gauges. When you buy all these material components from one source you save time, effort and money.

Your assembly costs are kept to a minimum when you use Carlson's abrasive cut material. Cleaner edges mean less true-up time on the job. There is no heat-affected zone because little heat is developed during the cutting. Fabrication is easier and the finished product is of the highest quality, more dependable in use.

Who pays freight on "offcuts" you can't use? No one, when you use Carlson's service for cutting plate to shape, ready for your fabrication. Plate is sheared, sawed, flame or abrasive cut and machined to your specifications. Eliminating freight charges on excess material lowers your costs.

There's the matter of delivery which also means time and money to you. As specialists in stainless steels, Carlson has the diversified equipment and the technical and practical knowledge to produce the plate or shapes you want, the way you want them with delivery as promised.

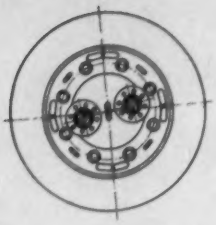
Stainless Steels Exclusively

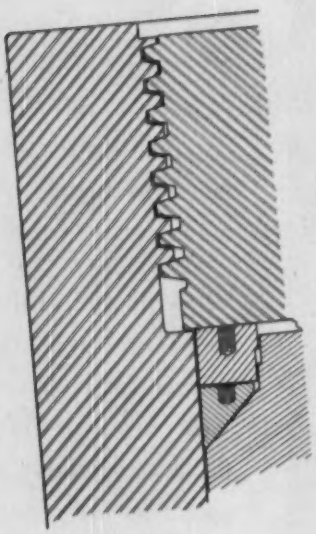
G. O. CARLSON Inc.

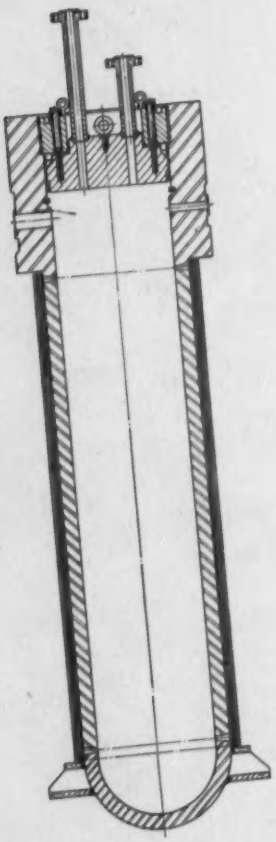
THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

DISCS • FORGINGS • FLANGES • BARS AND SHEETS (No. 1 Finish)







Only B&W Pressure Vessels offer—

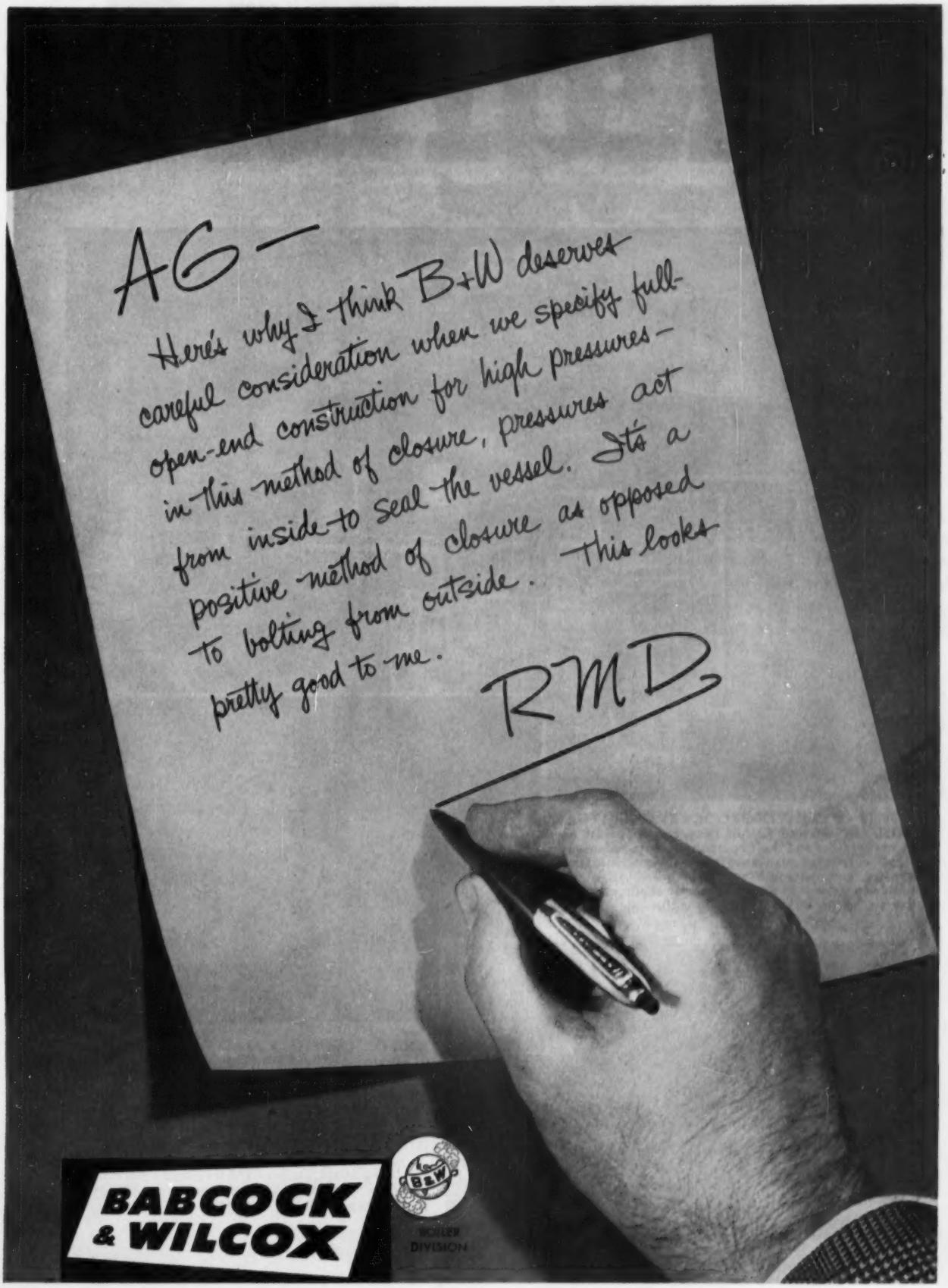
- Complete x-raying of critical welds
- Full longitudinal stress-relieving
- Banded construction (where desirable)
- Full open end construction (where specified)
- Hollow forging construction (where desirable)

BABCOCK & WILCOX

PRESSURE SEAL CLOSURE FOR HIGH-PRESSURE, FULL OPEN-END VESSEL

Every manufacturing step is a specialty operation developed out of long experience, and many B&W construction and testing methods are exclusive with B&W. Users of B&W Pressure Vessels get the maximum in sound construction and safe service.

It will pay you to get all the facts about B&W Pressure Vessels in relation to your requirements. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.


AG—
Here's why I think B+W deserves careful consideration when we specify full-open-end construction for high pressures—in this method of closure, pressures act from inside to seal the vessel. It's a positive method of closure as opposed to bolting from outside. This looks pretty good to me.
RMD
BABCOCK & WILCOX
B&W
BOILER DIVISION

World's

BATTERY OF CLEAVER-BROOKS EVAPORATORS IN ACTION—Revere Silicon Bronze was chosen for these evaporators and their component parts because of its high corrosion resistance and non-contamination properties, great strength and weldability. All of the components, as well as the 4 evaporator shells, are made of Revere Silicon Bronze Alloy No. 420.

ONE OF THE 4 EVAPORATOR SHELLS made of Revere Silicon Bronze, fabricated and installed by CLEAVER-BROOKS MFG. CORP., Waukesha, Wisconsin.

EIGHT TUBE SHEETS LIKE THESE were used in the Bermuda installation . . . 2 per evaporator. Each tube sheet, made of Revere Silicon Bronze, is 86" in diameter, 1¼" thick and weighed approximately 1,360 lbs. after drilling.

Largest

VAPOR-COMPRESSION SEA WATER DISTILLATION PLANT

Made and installed by CLEAVER-BROOKS

. . . Vital distillation units fabricated from REVERE SILICON BRONZE

This plant installed at the Kindley Air Force Base in Bermuda has a total daily capacity of 200,000 gallons and eliminates the dependence of the Base on rainfall or shipment of water by tankers.

Distilled water is produced in the ratio of 300 lbs. to each pound of Diesel fuel. Total costs are estimated at $1.25 per thousand gallons of distilled water. Nearly every component part made by Cleaver-Brooks is about twice the size of its largest previous counterpart. For example, the evaporators are 16½ feet high. Each, with its component parts, weighs approximately 40,000 lbs., the empty Revere Silicon Bronze shell alone accounting for 28,000 lbs.

There is an interesting story behind the development and manufacture of this equipment. The four huge pressure vessels had to be fabricated of Revere Silicon Bronze Alloy No. 420. Knowing Revere's wide experience in welding copper-base alloys, Cleaver-Brooks called in a Technical Advisor, and gave him a complete set of blueprints of the vessels, with a request for suggestions regarding joint design and welding techniques. He in turn consulted the Welding Section of the Revere Research Department. Their recommendations were adopted, and the customer reported that the original estimate of welding time had been cut considerably, reducing production costs correspondingly.

The Revere Technical Advisory Service is glad to collaborate on problems involving the specification and fabrication of copper and copper-base alloys, and aluminum alloys. See the nearest Revere Sales Office.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

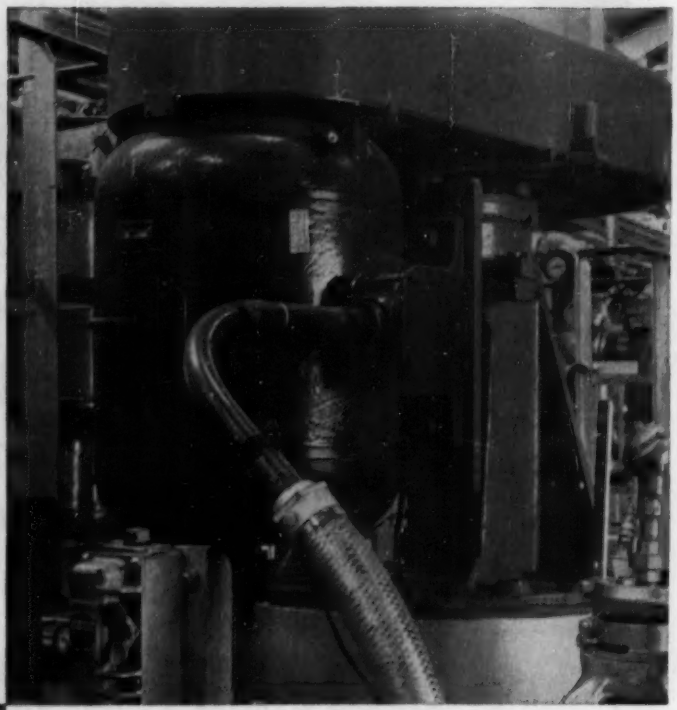
COPPER * BRASS * 18 01 * REVERE * ALUMINUM

THE STEAM SEPARATORS are identified by their conical tops and directional vanes. They are of the cyclone type, which is a patented feature of CLEAVER-BROOKS evaporators, and remove entrained water from the steam, thus preventing contamination of the fresh water coming from this unit. The result is an extremely high purity of the fresh water product.

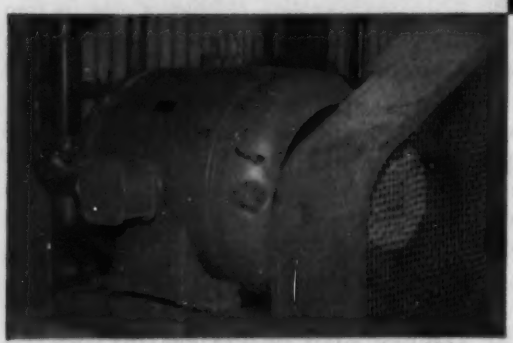
The rectangular objects at rear of photograph are the "Downcomers" which bring water down from the top of the steam separator. The tubes in left foreground are "Hotwells," which receive the distilled water discharge from the evaporator shell.

Wagner®
ELECTRIC MOTORS
...the choice of leaders in industry

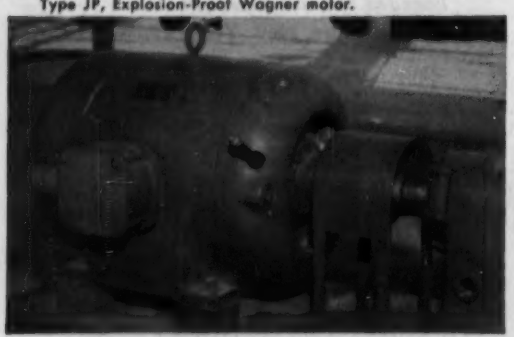
General Tire depends on Wagner Motors to furnish plenty of power for new chemical plant



This 7½ hp, Type JP Cast-Iron Frame Wagner Motor drives a circulating water pump.



An agitator on a polymer reactor is driven by a 25 hp Type JP, Explosion-Proof Wagner motor.



This compressor is driven by a 50 hp, Type JP, Explosion-Proof Wagner Motor.

General Tire and Rubber Company's $6,000,000 integrated mono and polyvinyl chloride plant in Ashtabula, Ohio, is a big producer of the basic ingredient in flexible plastics.

All of the motors (and dry-type transformers) in this plant were made by the Wagner Electric Corporation. These Wagner Motors drive compressors, agitators, pumps and blowers. You've got to have motors with plenty of electrical and mechanical stamina to stand up under the hard steady grind demanded by applications like these. And, for a chemical plant, you usually want motors with sturdy corrosion-resistant cast-iron frames. The Wagner type JP totally-enclosed, fan-cooled motors used at this plant meet these specifications and are explosion-proof, as well.

You can improve the performance of your equipment by choosing Wagner Motors to power your compressors, pumps, and blowers. Wagner's diversified line of standard motors, from 1/6 to 500 hp, can be readily adapted to your requirements.

Bulletin MU-185 gives complete information on all Wagner Motors. Write for your copy today. Better yet, let a skilled Wagner engineer discuss your motor needs with you. Just call the nearest of our 32 branch offices.

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TURBA-FILM process unit

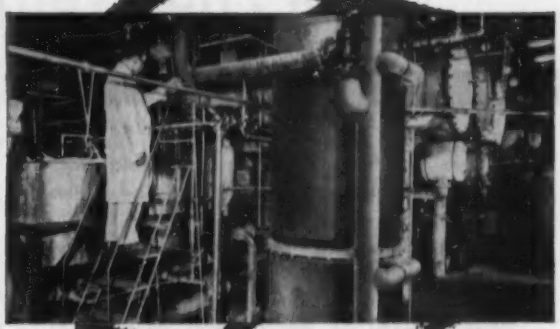
Reduces original equipment investment
Cuts steam and operating costs
Produces higher concentrate

Swift & Company specified the Turba-Film® process unit for concentrating gelatin liquor at their Kearney, New Jersey plant.

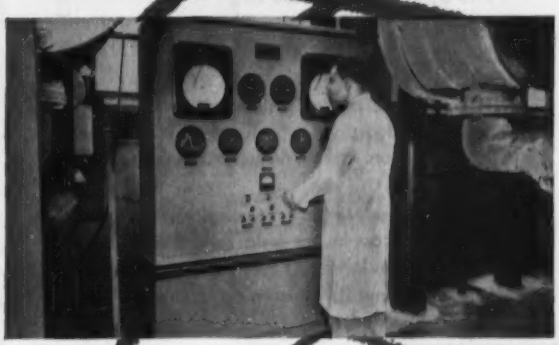
In this single-pass continuous operation the thin film of gelatin liquor spirals downward under continuous, turbulent agitation by the rotor blades. Heat transfer rate is extremely high since each particle of material is in contact with the heated surface for only a few seconds. There is no "cooking" or loss of flavor because there is no localized overheating; basic properties of the product are retained in the concentrate.

Gelatin poses many problems in processing because of its low heat transfer, tendency to foam, variations from initial to final viscosity, and heat sensitivity. The Turba-Film process unit is successfully solving these and many other problems throughout the chemical and allied process industries.

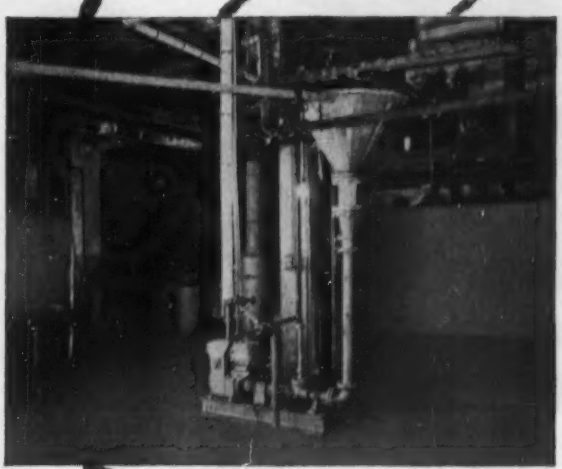
Without obligation, Rodney Hunt would like to discuss how the Turba-Film process unit can help you in normal or specialized applications, either as an individual unit or as part of completely engineered "package systems". Write for literature.



Gelatin li... ...ess steel tanks into th... ...rba-Film process unit at Swift & Co. This ...



Instruments s... ...n here control heat... ...gelatin liquor... ...d rate and heat are closely c... ...rolled during this ...tinuous single-pass operati...



After leaving Tur... ...film unit, gelatin concentrate is pumped to a receiving tank, from which it goes ... dryer.

RODNEY HUNT®

RODNEY HUNT MACHINE CO.

Process Equipment Division

31 Vale Street, Orange, Massachusetts, U. S. A.

WHAT'S THE PRICE OF THIS AGITATOR?

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The engineering "price tag" — your assurance the Nettco drive is the right size, the right speed, the right horsepower, the right shaft diameter — backed by Nettco's over 50 years of serving the agitation needs of Industry.

The operating "price tag" — your assurance the Nettco unit is engineered for low power consumption and high productivity — two vital economy factors in any processing system.

The maintenance "price tag" — your assurance the Nettco drive will minimize maintenance: with a minimum of moving parts — all conservatively rated.

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NETTCO
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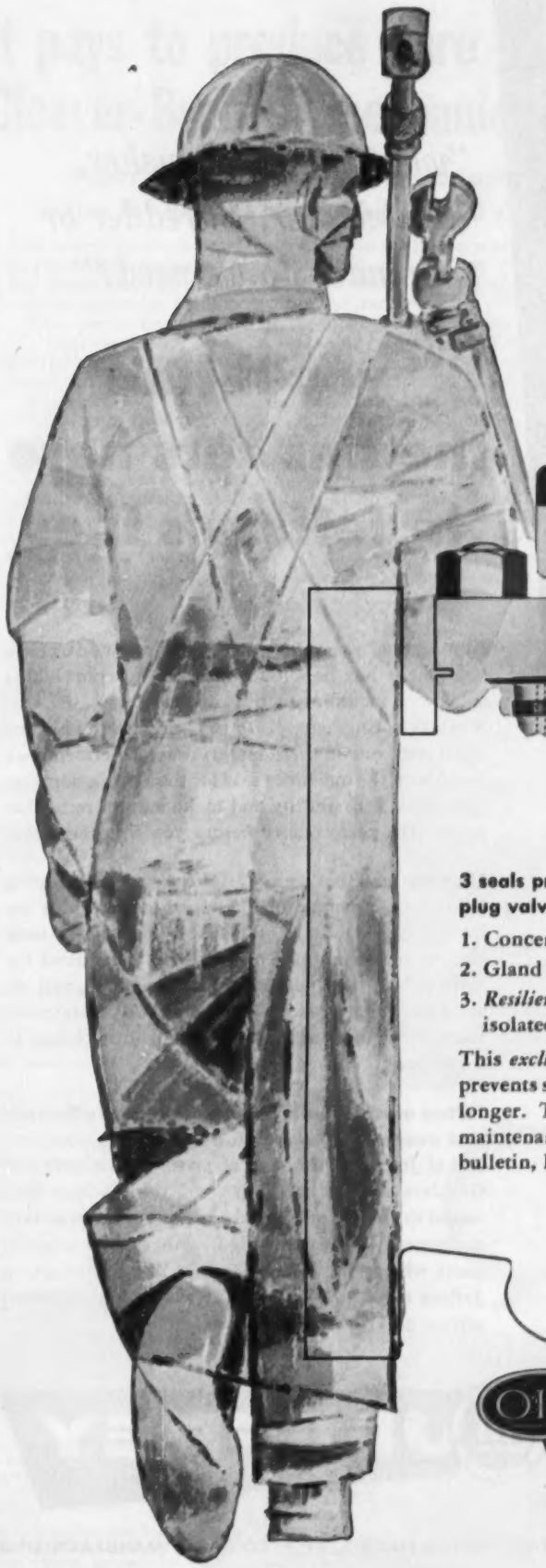
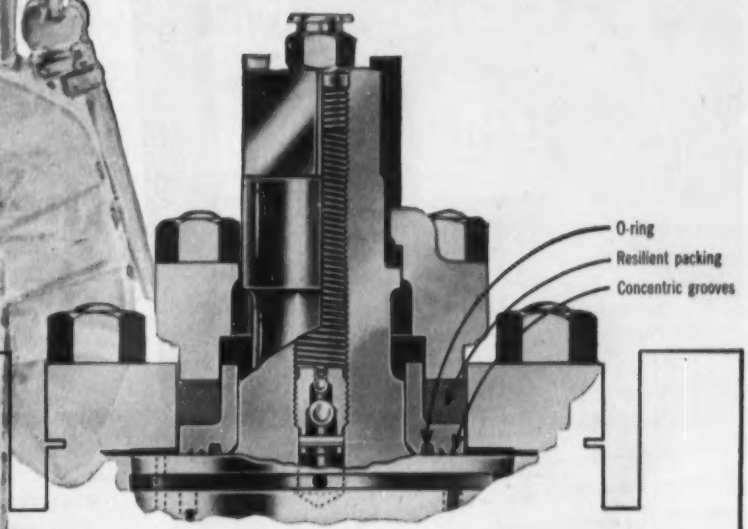


He'll tell you they don't leak



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3 seals prevent shank and gland leaks on OIC lubricated plug valves.

1. Concentric grooves form a *labyrinth seal.*
2. Gland liner also retains an *O-ring*—a second seal.
3. *Resilient packing* forms a third seal . . . is completely isolated from all moving parts.

This *exclusive* OIC lubricated plug valve design not only prevents shank leaks, it also helps retain gland adjustment longer. That's why OIC plug valves rate high with maintenance men. For details write for the new OIC bulletin, Form No. 1003-R.

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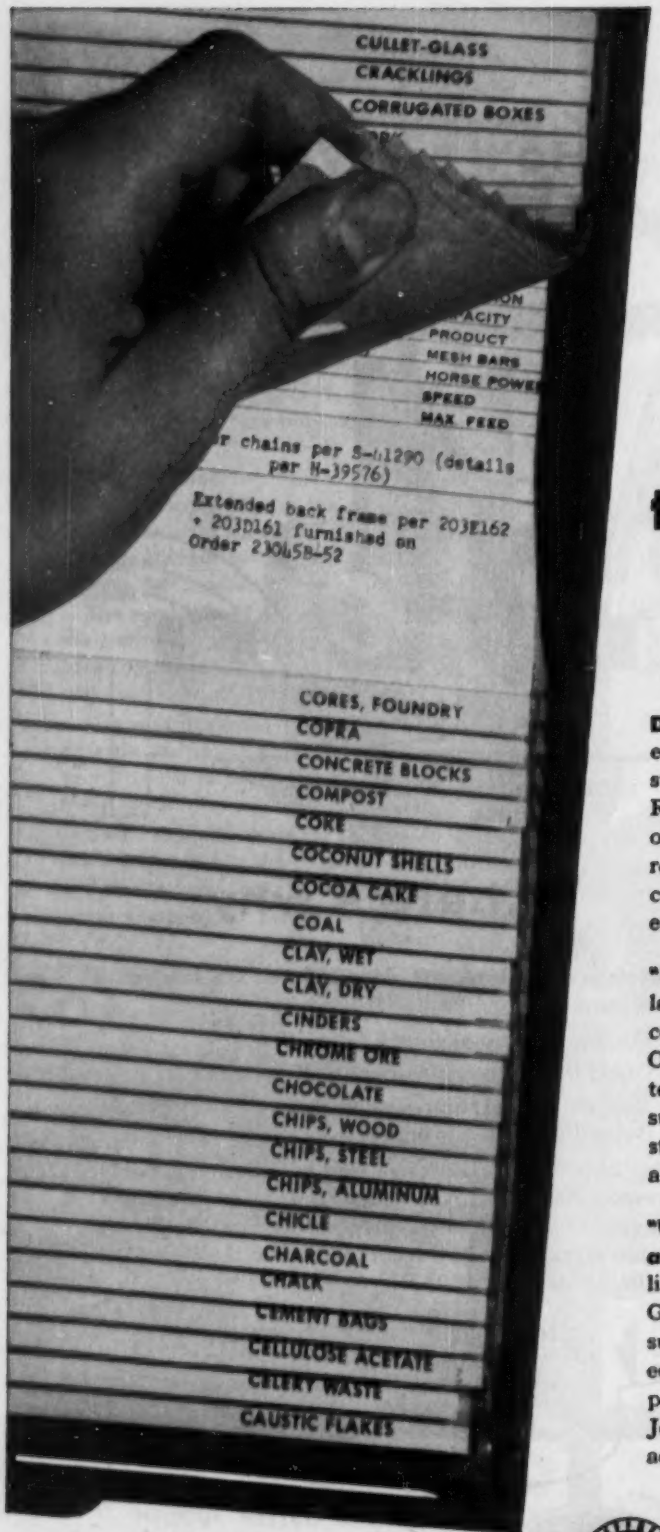
FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES



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you'll find the answers here in Jeffrey's files

During the past 60 years, Jeffrey reduction equipment has handled almost every conceivable substance, including many you'd never imagine. Our Reduction Engineers have in their files the history of all tests run on these materials, plus performance records on the machines sold for their reduction. You can check with Jeffrey and make sure of reduction equipment performance *before* you sign the order.

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"What machine will give us maximum efficiency and economy of operation?" The long, complete line of Jeffrey Crushers, Pulverizers, Shredders and Grinders enables us to give you the machine best suited to your specific needs. In most cases, standard equipment is recommended, with special internal parts where they are necessary. You can count on Jeffrey engineers to give you reliable and unbiased advice on crushing problems.

There is no substitute for know-how. *An outline of your reduction problems is all we need to submit recommendations. Write The Jeffrey Manufacturing Company, Columbus 16, Ohio.*

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it pays to produce pure water with a Cleaver-Brooks "mechanical oasis"

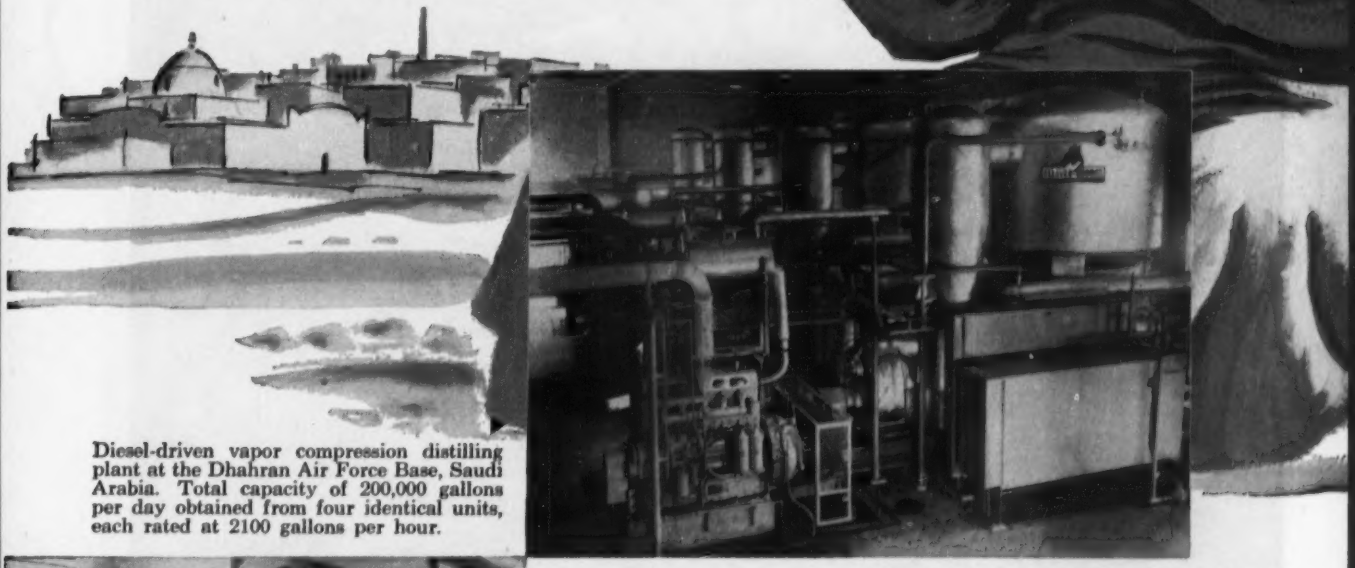
Vapor compression units deliver potable water for as little as $1.25 per 1000 gallons

Raw water source is brackish well water feeding one of the world's largest vapor compression evaporators installed at the Dhahran Air Force Base in Saudi Arabia. At the other end of the system —tasty, palatable drinking water, far exceeding USPH standards.

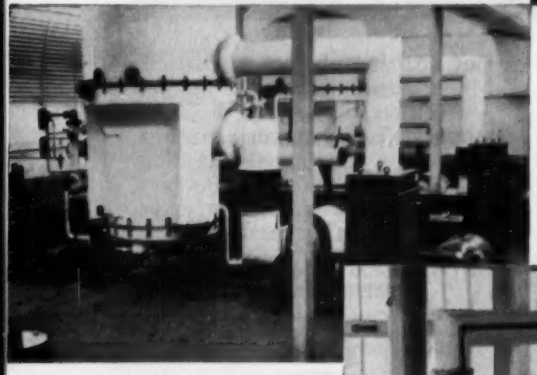
This performance is being repeated daily—all over the world . . . wherever fresh water is scarce and costly. Studies show operating costs are exteremely low. Three hundred pounds of fresh water, for example, are produced for every pound of Diesel fuel.

Any raw water source will do. Sea water, brackish, contaminated pools, streams are typical. You eliminate long pipelines, trucking, barging, plus chances of delivery failures.

Regardless of your pure water requirements—it will pay you to investigate Cleaver-Brooks evaporation equipment for commercial, industrial, municipal and marine applications. Write: Cleaver-Brooks Company, Special Products Division, Dept. M, 345 E. Keefe Ave., Milwaukee 12, Wisconsin, U.S.A. Cable Address: CLEBRO—Milwaukee—all codes.



Diesel-driven vapor compression distilling plant at the Dhahran Air Force Base, Saudi Arabia. Total capacity of 200,000 gallons per day obtained from four identical units, each rated at 2100 gallons per hour.



CLEAVER-BROOKS EVAPORATORS ARE IN SERVICE 'ROUND THE WORLD.

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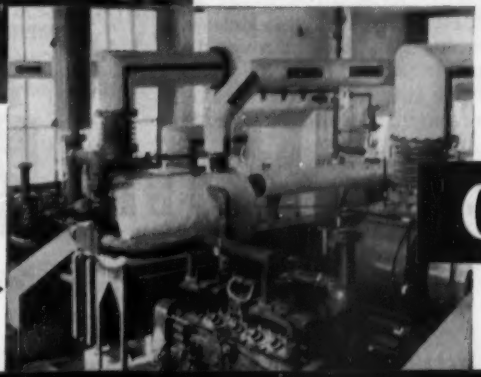
TODAY — Cleaver-Brooks evaporation equipment users include public water utilities, pharmaceutical houses, beverage bottlers, distillers, oil companies and divisions of our armed forces. There's a choice of sizes from 40 gph to 2100 gph in single units — larger units in multiple installations.



▲ This 1200 gallons-per-hour sea water distilling plant is located at Gibraltar on the Mediterranean. It is electrically driven.

Two 1200 gallons-per-hour vapor compression, diesel-driven plants located in Port Etienne, French West Africa. ▶

Cleaver Brooks®

25th YEAR

BUILDERS OF EQUIPMENT FOR THE GENERATION AND UTILIZATION OF HEAT AND POWER

We Make Them in All Sizes

Bethlehem is equipped to build every size and type of forged vessel you ever require. Whether your needs run to the small, special-service units or to giants weighing many tons, you can rely completely on Bethlehem's experience.

Shown on this page are a couple of interesting examples. The twin vessels resting side by side weigh less than five tons each. Their maximum OD is approximately 22 in. Though slim, trim little fellows, they are intended for relatively high pressures.

They are of course much lighter than that burly, rugged unit in the lower picture. There you have a vessel that is 30 ft long and weighs 25 tons. It's a reactor with a 36-in. OD, and with big, husky components throughout.

In the course of a year Bethlehem builds many other sizes and types of pressure vessels. Some are so huge that they exceed 150 tons in weight, finish-machined. But size is only one yardstick. Much more important is quality —precision engineering, precision materials, precision workmanship. These are the ingredients that make Bethlehem forged vessels so thoroughly dependable, even under the most exacting conditions.

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BETHLEHEM STEEL

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NEW STANDARDS
OF PERFORMANCE...
Another
LUNKENHEIMER
FIRST!
THE
LQ600
VALVE
FIG. LQ600-200
200 lb. S.P.—400 lb. W.O.G.
550° F.
FIG. LQ600-150
150 lb. S.P.—300 lb. W.O.G.
¼ to 2 inches
Thousands of these valves have served for as long as five years without replacement, regrinding, maintenance, or leakage—even on the most severe services. Their patented Brinalloy* seats and discs are more resistant to wear and corrosion than 500 Brinell Stainless Steel . . . even outlast case-hardened Stainless Steel exceeding 1000 Brinell. LQ600 Valves practically eliminate maintenance costs!
*Patented Alloy—T. M. Reg.
SEE YOUR LUNKENHEIMER DISTRIBUTOR
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THE LUNKENHEIMER CO., CINCINNATI 14, OHIO
LUNKENHEIMER®
THE ONE Great NAME IN VALVES
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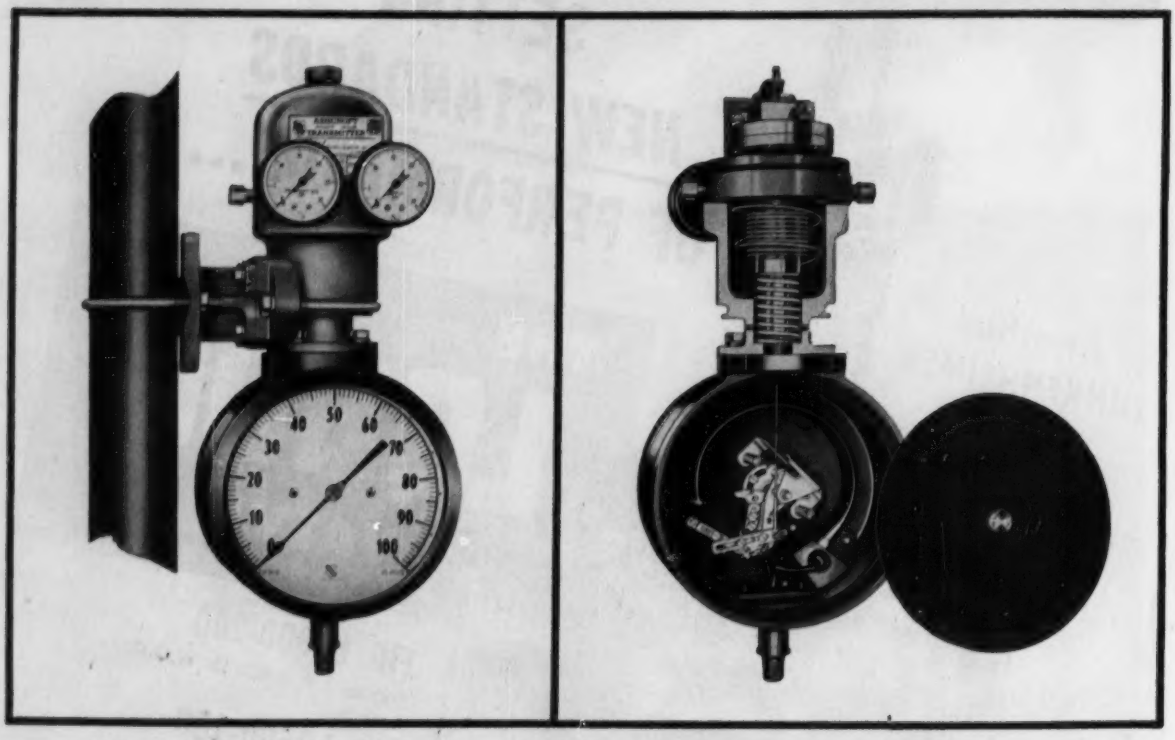
Designed to solve safety and service problems

...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6" indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to 100,000 psi with complete safety for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

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ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES *Muskegon, Mich.*

BLUE RIBBON
PRODUCTS PROVIDE
FASTER FABRICATION
because they're finished ALL OVER
It takes less handling, eliminates preparation time, and saves actual fabrication time when you use OTM Blue Ribbon flanges and fittings. Because OTM products are machined to closer tolerances than any other in the industry — and they're finished all over — clean and ready to weld. You save big on costly fabrication time with ALL Blue Ribbon flanges and fittings!
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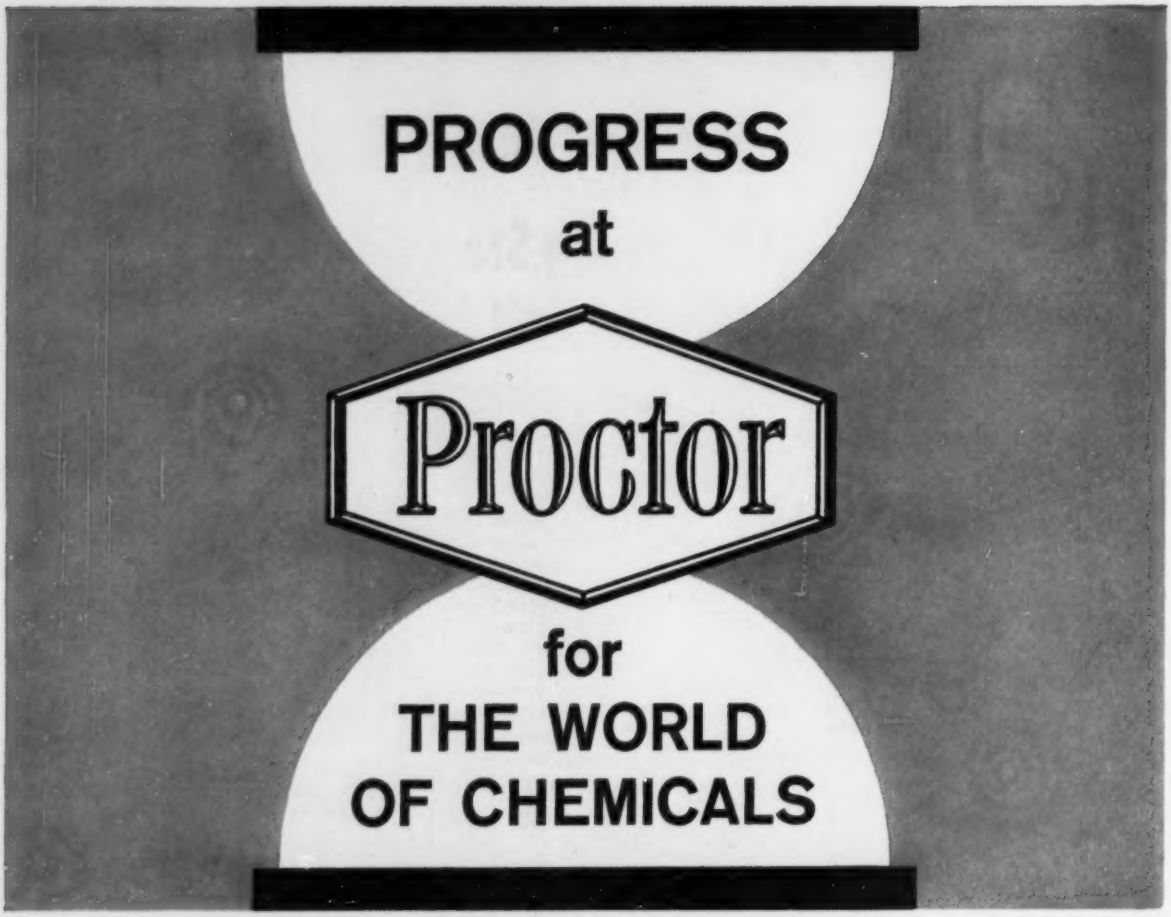


Proctor engineering and production of quality drying equipment has blazed a trail for the chemical process industries

5 DECADES OF PROGRESS

1900	Tray Truck Dryers
1923	Job-Engineered Continuous Conveyor Dryers
1923	Chemical Loop Dryers
1934	Fin Drum Feed
1937	Granulator
1938	Roller Extruder
1938	Scoring on Filter
1953	Spray Dryer

In over five decades of improvement in drying methods, Proctor has steadily advanced the continuous processing of chemicals and allied products, and has thus paved the way for growth, expansion, and diversification throughout the industry.

The success of Proctor continuous drying systems in the chemical industry alone, demonstrates Proctor's ability to produce the best drying equipment for rugged, dependable service. Through the development of test methods and test facilities, through an understanding of the needs of the processor, through engineering experience and manufacturing skill, the name Proctor has become synonymous with quality drying the world over.

Proctor **PROCTOR & SCHWARTZ, Inc.** PHILADELPHIA 20, PA.

Manufacturers of Industrial Drying Equipment and Textile Machinery

Using Salt Efficiently

by **INTERNATIONAL SALT COMPANY, INC.**—America's largest producer of salt

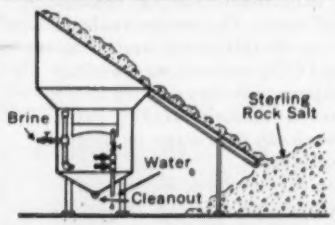
Combining Storage and Feeding Makes Salt Handling Easier

To save both time and manpower in salt handling—many plants have installed salt-storage units which feed directly into a salt dissolver. These units are particularly useful in plants where large tonnages of salt are consumed every day. But even in smaller plants, combination storage and feeding units are proving valuable. This is because they cut down on the amount of floor space needed to store salt.

In plants where floor space is at a premium, salt is often purchased in bags to permit high stacking. Here, too, combination storage and feeding units can produce substantial savings. They permit the purchase of economical bulk rock salt—and reduce salt-handling costs to a minimum.

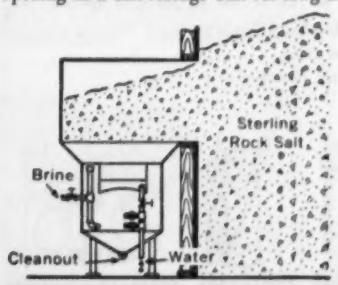
What about one of these units for your plant? Here are six of the most practical designs for combining salt storage and feeding. One of them—or an adaptation of the basic design—may be effective in saving floor space and lowering salt-handling costs for you.

1. Filling dissolver from floor pile. If salt must be stored in bulk on the same floor



as the dissolver (all dissolvers shown here are International's famous Sterling Model Lixator), an excellent feeding device is a portable belt conveyor. The best type for moving salt is made of aluminum with a rubber belt, and is between 16′ and 20′ long. The same conveyor moves salt not only from a floor pile into the Lixator, but also from a car or truck into the plant.

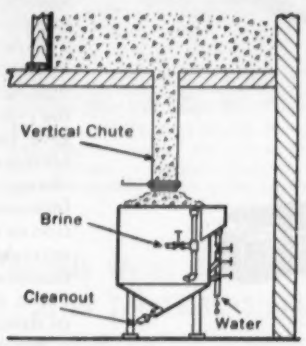
2. Wall-type hopper, bolted directly to an opening in a salt-storage bin. As long as



the salt supply in the bin is sufficiently high to permit gravity flow into the Lixator hopper, feeding will be automatic. When salt supply is no longer self-feeding, the operator stands on the salt in the bin and shovels directly into the hopper.

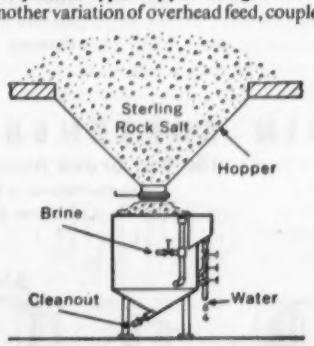
3. Overhead storage with gravity feed into hopper. This design is often used when uninterrupted salt feed is needed, but the storage floor has relatively little salt capacity. A cylindrical-type hopper directly under the hatch holds a large amount of salt for feeding the Lixator—and acts as a substantial secondary storage unit. Ordinarily, though, if salt can be stored above the Lixator, the next design is preferable.

4. Overhead storage with vertical chute. This direct-feed unit is a practical, econom-



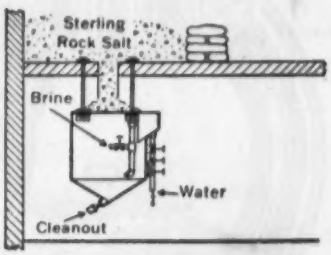
ical way of operating the Lixator. If storage capacity on floor above is large enough, no hopper is needed, which means a considerable saving. Feed is automatic because of angle of repose for salt.

5. Pyramid-type hopper design. This is another variation of overhead feed, coupled



with large storage capacity. But if storage space on floor above is limited, this design is also practical. Salt can simply be dropped into the hopper through a large hatch with a removable cover.

6. Lixator hung above floor, to save floor space. A very desirable design when



floor space is at a premium. Design here also shows use of a few salt bags to act as a storage-bin wall—in lieu of a permanent bin structure.

One final note about the equipment shown here. All Lixators operate on exactly the same principle. They vary only in size and capacity, and in methods of delivering salt to the dissolver unit. All Lixator designs are exclusive International Salt Co. developments, properly protected by patents and patents pending.

TECHNICAL SERVICE WITH YOUR SALT

Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all types and sizes. And we also make automatic dissolvers in metal or plastic for both kinds of salt. So we can recommend the type and size of salt most perfectly suited to your needs.

If you'd like the assistance of an International "Salt Specialist" on any problem concerning salt or brine—or further information on salt storage and methods of feeding salt—just contact your nearest International sales office.

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STERLING SALT
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In Water
it's often what you can't see that hurts you!

Anyone concerned with water-using equipment is perfectly aware that you can't see the dissolved minerals in ordinary water... the kind of water that can cause trouble and expense wherever it is used. This is just our way of reminding you that thousands of plants, institutions and other water users throughout the country are avoiding trouble and expense with Elgin Water Conditioning equipment.

Based upon scientific water analysis and a thorough study of your problem, Elgin will submit a complete proposal covering the type of water treating system which will give you the best and most economical service. This may mean simply ion-exchange softened water. Or, maybe analysis indicates need for dealklization, neutralization or silica and CO_2 removal. At the other extreme, your operations may require water free of all minerals, alkalinity, acidity, gases ... in short *chemically pure water* by means of deionizer equipment.

Whatever the case may be, Elgin equipment and Elgin water treating methods, plus Elgin experience and skill, can solve your problems... with maximum efficiency at minimum cost. Talk over your water problems with the Elgin representative in your vicinity who can put at your disposal all the skill and knowledge of Elgin's half-century of service. Or write us direct.

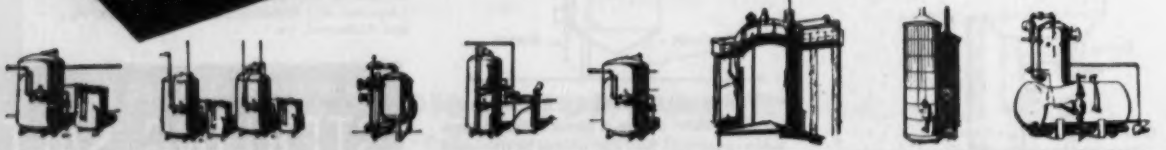
ELGIN WATER CONDITIONING

ELGIN SOFTENER CORPORATION

160 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities

In Canada: G. F. Sterne & Sons Ltd., Brantford

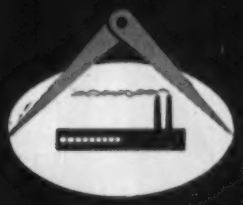


SOFTENERS ION EXCHANGERS FILTERS DEIONIZERS DEALKALIZERS LIME COAGULATORS DEGASITORS DEAERATING HEATERS

Using

DU PONT ELASTOMERS

NEOPRENE • HYPALON®



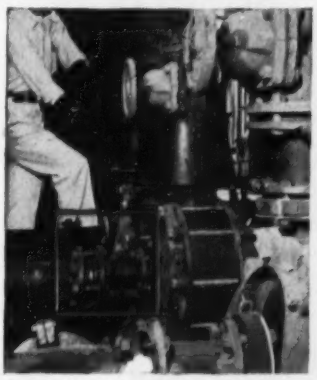
in Industry

NEOPRENE connectors save $1,000 a year in hydrochloric acid area

At a large midwestern chemical plant, long-lasting neoprene connectors have replaced the original fittings used to connect Karbate pumps to suction and discharge lines. This switch represents a saving in materials and labor of $1,000 a year.

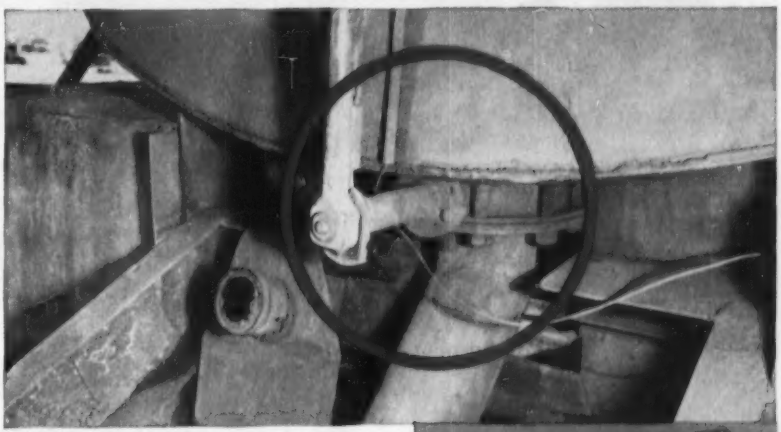
Although the previous materials used were chemically suitable to handle hydrochloric acid, they were rigid, and pump vibrations cracked them. Resilient neoprene connectors are unimpaired by exposure to hydrochloric acid and they are flexible enough to resist vibration to compensate for shifting lines without being damaged.

Neoprene resists oil, grease, heat, weather and chemicals and operates successfully under many of the industry's toughest exposure conditions. Mail the coupon for more information. Include your specific problems.

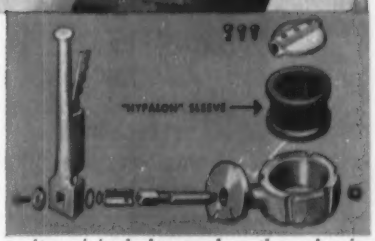


Flexible neoprene connectors resist hydrochloric acid, allow for misalignment between pumps and suction and discharge lines.

HYPALON® eliminates sleeve maintenance costs in butterfly valve handling spent acids



The resilient HYPALON sleeve in this butterfly valve snaps into the ring piece. It acts as both a valve seat and as the gasket between the ring piece and mounting flanges, giving a perfect seal.



ORIGINAL VALVES STILL ON DUTY AFTER TWO YEARS' SERVICE

Industrial Wastes, Inc., of Beaver Falls, Pa., hauls about 2½ million gallons of spent acids each month in its fleet of tank trucks. About two years ago, the company faced the problem of finding an all-purpose tank outlet valve which would give longer service.

They tried a butterfly valve with a sleeve of HYPALON. Here's how it works: An acid-resistant metal damper rotates in a ring piece lined with a HYPALON sleeve. As the valve closes, the metal disk distorts the resilient HYPALON sleeve to form a pressure-tight seal. The sleeve returns to its original shape when the valve is opened.

The resistance of HYPALON to sulfuric, nitric, hydrochloric and hydrofluoric acids has kept the valve in operation for *two years*—with a minimum of maintenance. Can HYPALON help you? This versatile synthetic rubber also has unusual resistance to hardening at elevated temperatures (250° to 350°F.)... is virtually ozone-proof . . . and can be fabricated into hose, gaskets, belts, linings or prepared as solution coatings. For more information, clip and mail coupon.

DU PONT

REG. U.S. PAT. OFF.

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

☐ I am particularly interested in _____

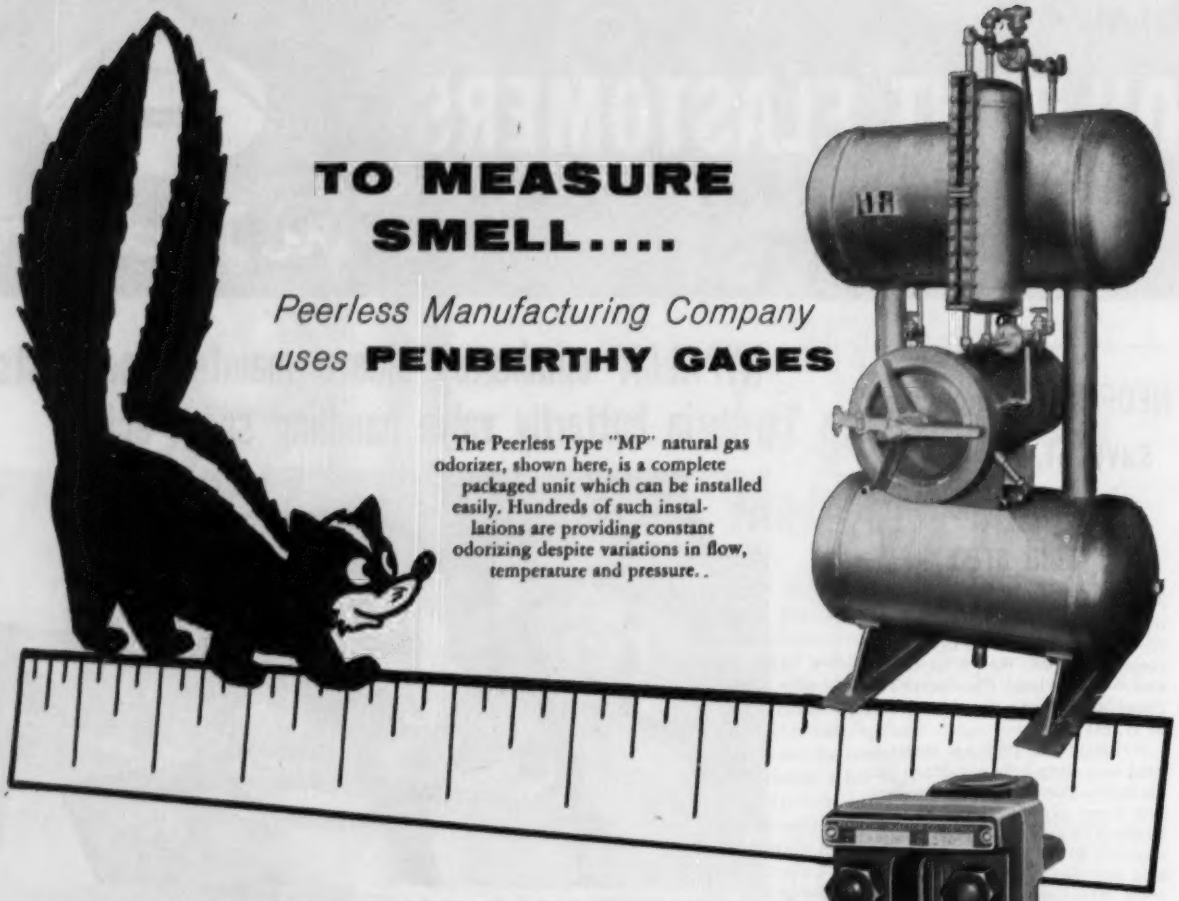
☐ Please add my name to the mailing list for your free publications, "The Neoprene Notebook" and "Facts about HYPALON."

E. I. du Pont de Nemours & Co. (Inc.)
Elastomers Division, Dept. CE-11
Wilmington 98, Delaware

Name _____
Firm _____
Address _____
City _____ *State* _____

TO MEASURE SMELL....

Peerless Manufacturing Company uses **PENBERTHY GAGES**



The Peerless Type "MP" natural gas odorizer, shown here, is a complete packaged unit which can be installed easily. Hundreds of such installations are providing constant odorizing despite variations in flow, temperature and pressure..

IMPORTANT to the Gas Companies, from a liability standpoint, is the dependable means of maintaining accurate records of daily odorant consumption. This is done by means of the Penberthy Reflex Liquid Level Gages... shown mounted on the small calibration tank. Two calibration scales are attached to the gage glass. One records gallonage in the large storage tank and the other in the small.

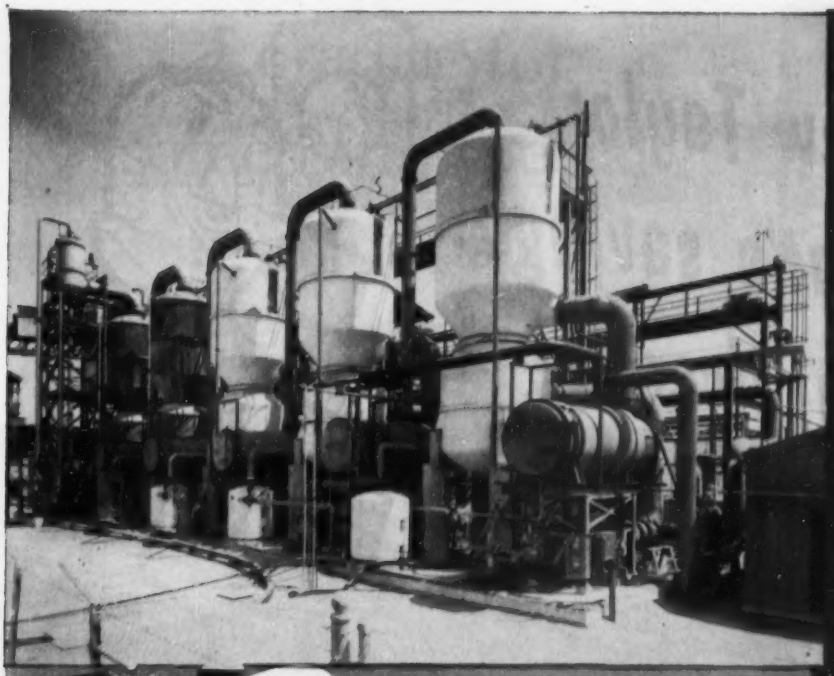
Like Peerless, other equipment manufacturers depend upon Penberthy Gages for clear accurate readings, durable service and minimum maintenance. This is because of the extra exclusive features incorporated into the advanced engineering and construction of Penberthy Gages and Gage Valves. Let us send you complete detailed information on the complete line.

WRITE FOR YOUR COPY OF CATALOG 35.

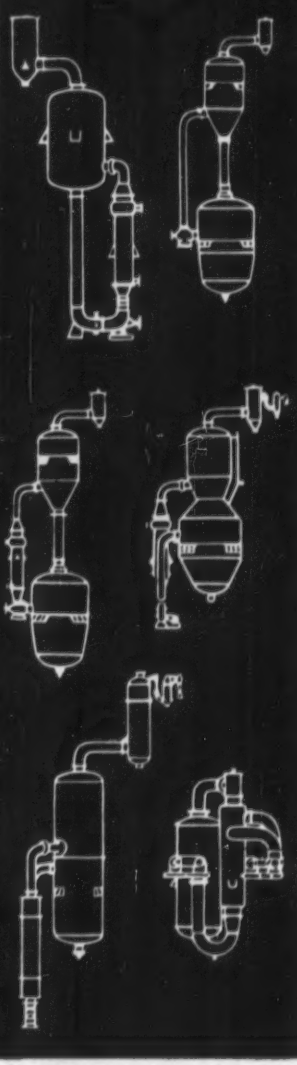
PENBERTHY MANUFACTURING CO.
Division of the Buffalo-Eclipse Corporation
1242 Holden Avenue Detroit 2, Michigan

There's certain satisfaction in **PRODUCTS BY** PENBERTHY

- GAGES
- EJECTORS
- EDUCTORS
- EXHAUSTERS
- SYPHONS
- ELECTRIC SUMP PUMPS
- CYCLING JET PUMPS
- INJECTORS



OTHER TYPES OF CRYSTALLIZERS STRUTHERS WELLS BUILDS



Crystallizers*

Regardless of size, every Struthers Wells "Krystal" Crystallizer has operating economy engineered into its basic design.

The ability to produce a controlled crystal size of exceptional uniformity means—

1. BETTER DEWATERING ON CENTRIFUGE OR FILTER	$	SAVINGS
2. LOWER DRYING COST	$	"
3. ELIMINATION OF DUST LOSS	$	"
4. FREE-FLOWING, NON-CAKING PRODUCT	$	"
5. HIGH PURITY CHEMICAL	$	"
6. ADDED SALES APPEAL	$	"
TOTAL	$	REAL SAVINGS

Why not take advantage of the extensive experience of Struthers Wells engineers in applying the many cost saving advantages of the Struthers Wells "Krystal" Crystallizer design to your particular problem.

*Photo courtesy Filtrol Corporation, Los Angeles, Calif.

STRUTHERS WELLS Corporation

WARREN, PA. Struthers Wells Plants at Warren and Titusville, Pa.

Representatives in Principal Cities

STRUTHERS WELLS PRODUCTS

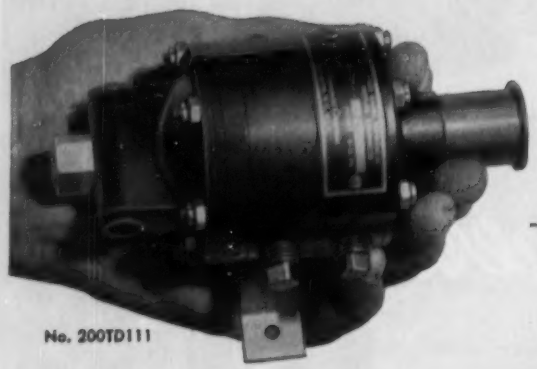
PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION
MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

"That new Taylor Instrument's saving us money already!"



No. 200TD111

He's talking about the new Taylor low-cost Flow Transmitter!

THE reason he can spot the savings so quickly is that the No. 200TD111 Fixed Range Differential Pressure Transmitter is being used to measure departmental consumption of steam, air and water that previously went unchecked. That 3-pen recorder in the background shows at a glance how much is being used by a given department as a basis for apportioning costs. It's the remarkably low price of this new instrument that makes it such a practical cost accounting aid on applications hitherto considered marginal.

Measuring only 6½" x 3" and weighing only 4½ lbs., its simplified piping, force-balance construction and external adjustments make it easy to install and maintain. Calibration accuracy is better than 1%. Sensitivity exceeds 0.1%. Ranges 0 to 50, 100, 200 and 300 inches of water. Built for rough service and outdoor mounting.

Call your Taylor Field Engineer, or write for **Bulletin 98274.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

DESIGN SPECIFICATIONS

Diaphragm of Neoprene-impregnated Nylon.
Body material, brass.
Maximum working pressure: 150 psi.; temperature 150°F.
Air Supply pressure, 20 psi.
Air consumption, 0.10 standard cu. ft. per minute.
Output pressure range 3 to 15 psi.
Size 6½" x 3". Weight 4 lbs. 9 ozs.
All connections ¼" internal NPT.

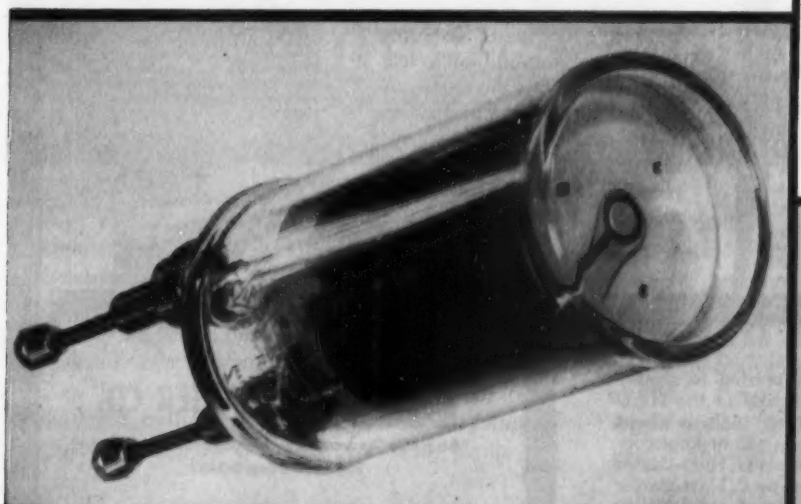
Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Looking for something special in materials?

Norton high-purity, high-stability materials aid in solving many industrial problems

. . . like these

In Supersonic Flight. Marquardt Aircraft Company of Van Nuys, Cal., uses Norton ROKIDE* protective coating in its new, highly advanced ramjet engines for supersonic missiles. The flame-sprayed ROKIDE aluminum oxide coating greatly increases the tailpipe's resistance to excessive heat and erosion. Other ROKIDE coatings for high temperature applications include "ZS" zirconium silicate and "Z" stabilized zirconia.



In Concentrated Light. After inventing their outstanding new RF induction lamp, Sylvania Electric Products Inc. turned to Norton Company as a dependable source of high-melting, stable materials. Norton tantalum carbide was selected as the light-emitting source. Heated to a much higher temperature than tungsten filaments can stand, this material becomes the most uniform concentrated light source ever developed.

If lack of suitable materials is delaying development or improvement of your products, remember this:

Norton high-melting, fusion-stabilized materials have helped solve many such problems for manufacturers, in applications ranging from home appliances to guided missiles and atomic energy equipment.

Here is a partial list of Norton refractory materials: ALUNDUM* fused alumina, CRYSTOLON* silicon carbide, MAGNORITE* fused magnesia, NORBIDE* boron carbide, fused stabilized zirconia, special fused oxides, refractory carbides and borides.

Another point to remember: these materials offer you combinations of thermal, electrical and physical characteristics not available in the usual refractory substances. Melting points range up to 6400°F. Electrical resistance and thermal conductivity run from low to very high. NORBIDE boron carbide, with a Knoop hardness of 2800, is the hardest commercial material made by man.

Norton high-melting materials are the basic ingredient of the famous Norton Refractory R's — refractories *engineered and prescribed* for the widest range of industrial uses. Norton Company supplies them in crude, processed or fabricated form, and will work with you in engineering them to your requirements. For further information, write to NORTON COMPANY, Refractories Division, 510 New Bond Street, Worcester 6, Mass.

NORTON

REFRACTORIES

Engineered... Rx ...Prescribed

Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives Sharpening Stones • Behr-cut Tapes
*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

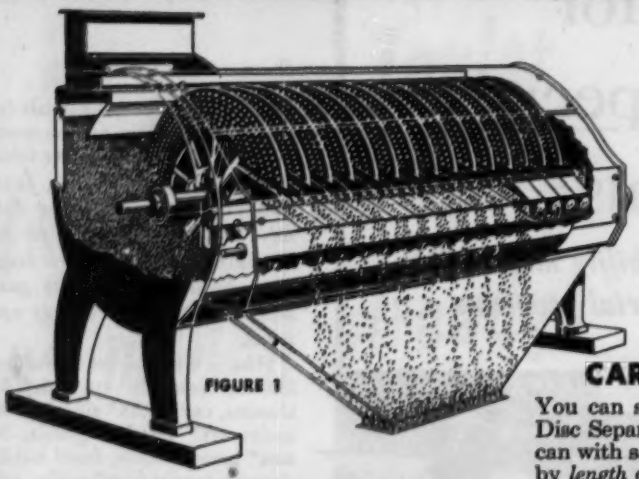


FIGURE 1

FIGURE 2

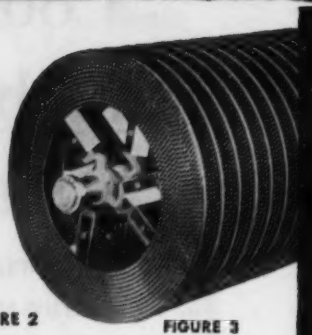


FIGURE 3

FOR ACCURATE LENGTH SIZING OF FREE-FLOWING GRANULAR MATERIALS

CARTER DISC SEPARATORS

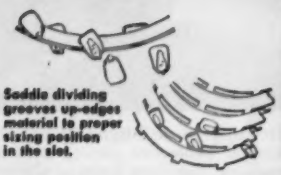
You can size free-flowing materials with Carter Disc Separators much more accurately than you can with screens. That's because Carter discs size by *length* differences. In each disc there are hundreds of under-cut pockets which lift short material and reject long material that does not fit into the pockets. Fig. 1 shows how material flows through the Disc Separator. Fig. 2 shows how the discs lift or reject. A series of discs is shown in Fig. 3. Sizes of Carter Disc Separators differ in the number of discs and in the diameter of the discs, and there is a wide range of pocket sizes and styles.

HART UNI-FLOW CYLINDER SEPARATORS

While *Disc* Separators perform *precise* separations, Uni-Flow *Cylinder* Separators are recommended when you need less accuracy or more flexibility. In the Uni-Flow Separator the material is lifted by semi-spherical indents (A) that line the inside surface of the cylinder. The operator controls the separation by raising or lowering the separating edge (C) of the trough (B) into which the lifted material falls.

CARTER PRECISION GRADERS For Sizing by Thickness or Width

Because of the unique design of the perforated cylinders used in Carter Precision Graders, these machines make separations to a degree of accuracy hitherto unobtainable. Thickness separations are made by slots at the bottom of grooves in the cylinder. Width separations are made by recessed round perforations in the cylinder.



Saddle dividing grooves up-edges material to proper sizing position in the slot.

Placing the perforation at the bottom of the recess causes the material to be up-ended and positively presented to the round perforations.

FREE TESTING You are invited to send—or bring—samples of your materials to the Hart-Carter laboratory for free testing. (Ask us about the size sample required.) Results will be kept confidential. Knowing your requirements, Hart-Carter will recommend the machines you need. Hart-Carter machines are being used to size such materials as polyethylene and nylon cubes, and catalyst pellets.

WRITE FOR FOLDERS that describe in detail the sizing methods used by each kind of machine.

HART-CARTER CO.

661 19th Avenue N.E., Minneapolis 18, Minn.
Phone: Sterling 9-2417

MACHINERY FOR SIZING FREE-FLOWING GRANULAR MATERIALS BY DIMENSIONAL DIFFERENCES

US RUBBER EXPANSION JOINTS

U. S. Rubber Expansion Joints insulate pipe lines against vibration, allow for expansion and contraction—*and* resist corrosion from the outside as well as inside.

These flexible pipe line connections resist attacks by acids, oils, chemicals, and abrasive materials. Even the flanges are rubber faced. And the continuous flexing of the rubber *prevents scale from forming.*

More and more chemical processing plants are turning to U. S. Rubber Expansion Joints because they are not only corrosion resistant, but also extremely durable. There are no moving parts to wear out.

U. S. Rubber Expansion Joints are readily installed on both new and old pipe systems. They are available, along with skilled engineering service, at any of the 28 "U. S." District Sales Offices. Or write us at Rockefeller Center, New York 20, N. Y.

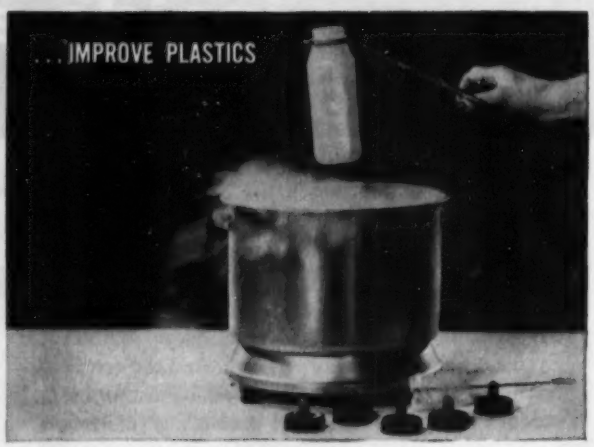
Watch NCAA Football, Saturday Afternoon, NBC-TV

Mechanical Goods Division
United States Rubber

HOW HERCULES HELPS...

ABOUT THIS PHOTOGRAPH—In capturing this closeup of corroded "coupons" and a distance shot of a refinery on the same negative, well-known photographer Bernard Hoffman achieved amazing depth of focus. Using revolutionary techniques which he has pioneered, Mr. Hoffman is able to achieve over-all sharpness of near and far objects—long the goal of photographers.

CORROSION COSTS MILLIONS every year for petroleum refiners. Metal losses as illustrated by these corroded coupons are the "danger signal" that corrosion is at work. Hercules Polyrad®, a corrosion inhibitor, prevents this damage. By forming a molecular film that protects the process side of refinery equipment from corrosive media, Polyrad drastically reduces "down time" for maintenance; cuts costly replacement bills.



ABLE TO WITHSTAND STERILIZING, this plastic baby bottle was molded from Hercules Hi-fax®, a new ethylene polymer. A completely new plastic, Hi-fax offers a combination of properties never before available, including four to five times the rigidity and twice the strength of conventional polyethylene. Hi-fax is now available for limited production runs.

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HERCULES

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SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS

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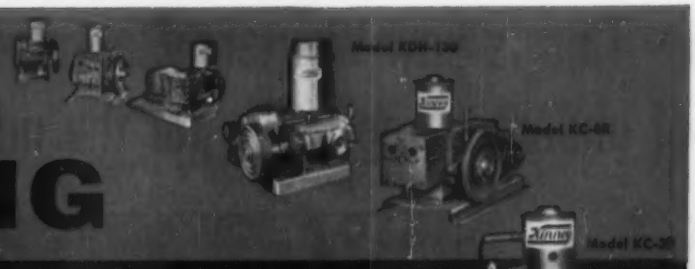
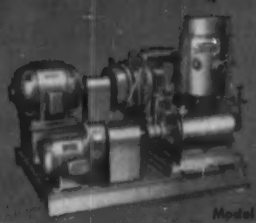
GROWING
GROWING
GROWING



*The Kinney® Vacuum Pump Line continues to grow . . . to meet industry's vacuum needs!!



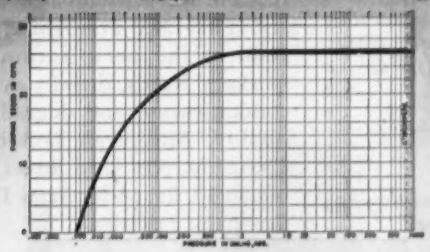
TOP VOLUMETRIC EFFICIENCY!

★ Swiftly, accurately, and consistently creates and maintains vacuum desired
★ Application versatility
★ Thorough dependability
★ Low maintenance requirements

Though already offering the world's largest line of vacuum pumps, Kinney caters to industrial progress and is constantly developing *new* pumps to meet the challenge it offers. If your process can be improved by better vacuum equipment, check the design features of these latest additions to the Kinney line . . . and benefit from our wealth of experience in designing and manufacturing quality products.

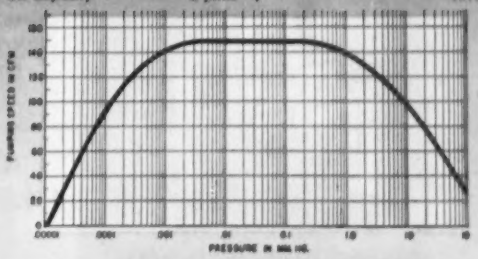
MODEL KD-30 SPECIFICATION DATA — Model KD-30
Single Stage-Duplex Design High Vacuum Pump

Ultimate Pressure (McLeod Gauge)	10 Microns	Cooling	Air
Free Air Displacement	30.4 CFM	Shaft Diameter	¾"
RPM	525	Inlet Connection	1½" screwed
Motor H.P.	1½	Outlet Connection	1¼" screwed
Oil Capacity	2½ qts.	Net Weight, Complete Unit	370 lbs.



MODEL KMB-230 SPECIFICATION DATA — Model KMB-230
Two Stage Mechanical Booster Vacuum Pump

Ultimate Pressure (McLeod Gauge)	0.1 Micron	Cooling	Water
Free Air Displacement	230 CFM	Shaft Diameter	¾" / ¾"
RPM	3600/640	Inlet Connection	4" flanged
Motor H.P.	2 and 1	Outlet Connection	1¼" screwed
Oil Capacity	5 pints	Net Weight, Complete Unit	1010 lbs.



Our engineers will gladly make recommendations on any of your vacuum equipment requirements. Request complete data today or contact one of our competently staffed district offices . . . in Baltimore, Charleston, W. Va., Charlotte, N. C., Chicago (La Grange), Cleveland, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis . . . or The International Sales Office, 90 West St., New York 6, N. Y.

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N.Y.

• Please send Catalog No. 425 describing the complete line of Kinney Vacuum Pumps.

★ Kinney Oil Jet Vacuum Pumps to be Displayed at the Cleveland Public Auditorium during the National Metal Exposition — Oct. 8th thru 12th

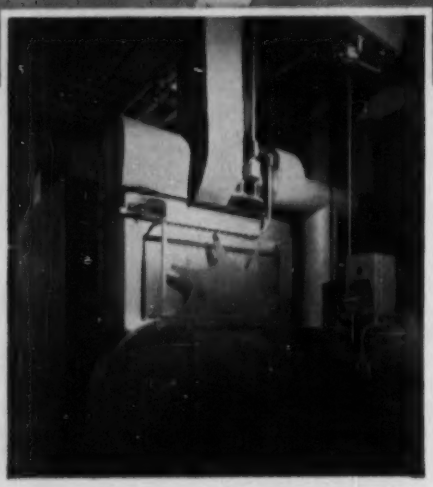
Name.....

Company.....

Street.....

City..... *State*.....

This is how Western Electric assures perfection of undersea repeaters for the new Transatlantic Cable



Even minute imperfections, visible only under the microscope, can disqualify repeater parts for use

Type CH air-conditioning Lectrodryer

51 repeaters in each of the two one-way cables make the new Transatlantic undersea telephone system possible. Designed to withstand shocks of laying and recovery, and the pressure of water at a two-mile depth, it is no wonder that Western Electric Company takes extreme care in manufacturing components.

A very low moisture content is required to obtain maximum stability and life of paper capacitors used in these repeaters. Paper, selected only after extensive life tests, is first stored in a room held below 20% relative humidity to assure that its moisture content has been reduced to that DRYness. Then the winding and assembly are done in this same room.

A Lectrodryer* maintains this room at the constant low humidity. The DRY atmosphere also reduces the perspiration from workers' hands, thereby avoiding contamination and degrading of quality. Pittsburgh Lectrodryer Company, 303 32nd Street, Pittsburgh 30, Pa. (A McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

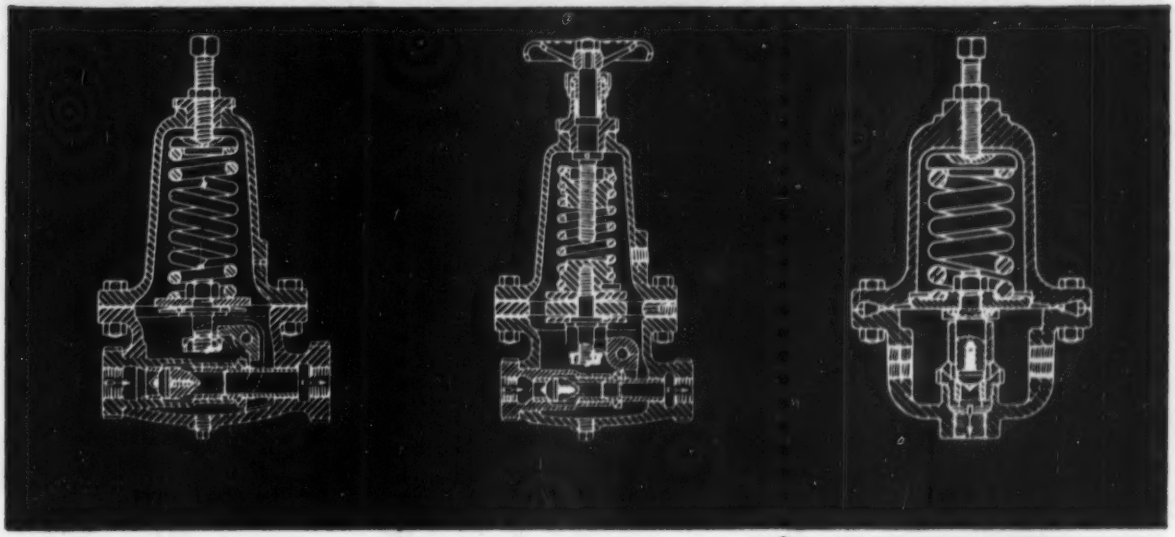
* REGISTERED TRADEMARK U.S. PAT. OFF.

YOUR CONTROL PROBLEM?

You'll find the Answer in

CASH STANDARD

Steam . . . Water
Air . . . Gas . . . Oil
REGULATORS FOR POWER
☑ GENERATION
☑ DISTRIBUTION



PRESSURE REDUCING VALVE

A streamlined high capacity valve for close pressure regulation—accurate even under toughest working conditions. Closes against the flow, eliminating conditions that cause chatter. Two types available: for high pressures and for low pressures. Recommended for steam, water, air, oil and most gases and chemicals. Screwed ends, sizes: ¼" to 2".

DIFFERENTIAL CONTROL VALVE

Maintains constant differential pressure between atomizing steam and fuel oil. Non-rising type adjusting screw adjusts spring either under tension or compression for maintaining steam above or below fuel oil pressure, depending on type of burner employed. Iron, bronze or steel body; bronze or stainless steel trim. Screwed ends, sizes ¼" to 2" with expanded outlets when desired.

RELIEF VALVE

Maintains a desired inlet pressure by relieving into relief line provided or protects equipment against high pressure line surges. For water, oils, air, gases, slurries and many other fluids. Bottom connection is outlet or discharge connection. Two side inlet connections permit installation in the line or as an angle valve with one side inlet plugged. For relief pressures to 325 lbs. and temperatures to 500° F. Screwed ends, sizes: ¼" to 2"; flanged ends, size ½".

Cash Standard Stacon Series V Self Operating Temperature Regulators

Type 57 Recording Controllers

Type 30 Diaphragm Control Valve With Type 51 Indicating Controller Mounted

Type 44 Pilot Operated Pressure Regulator

Type 100 Positioning Controller

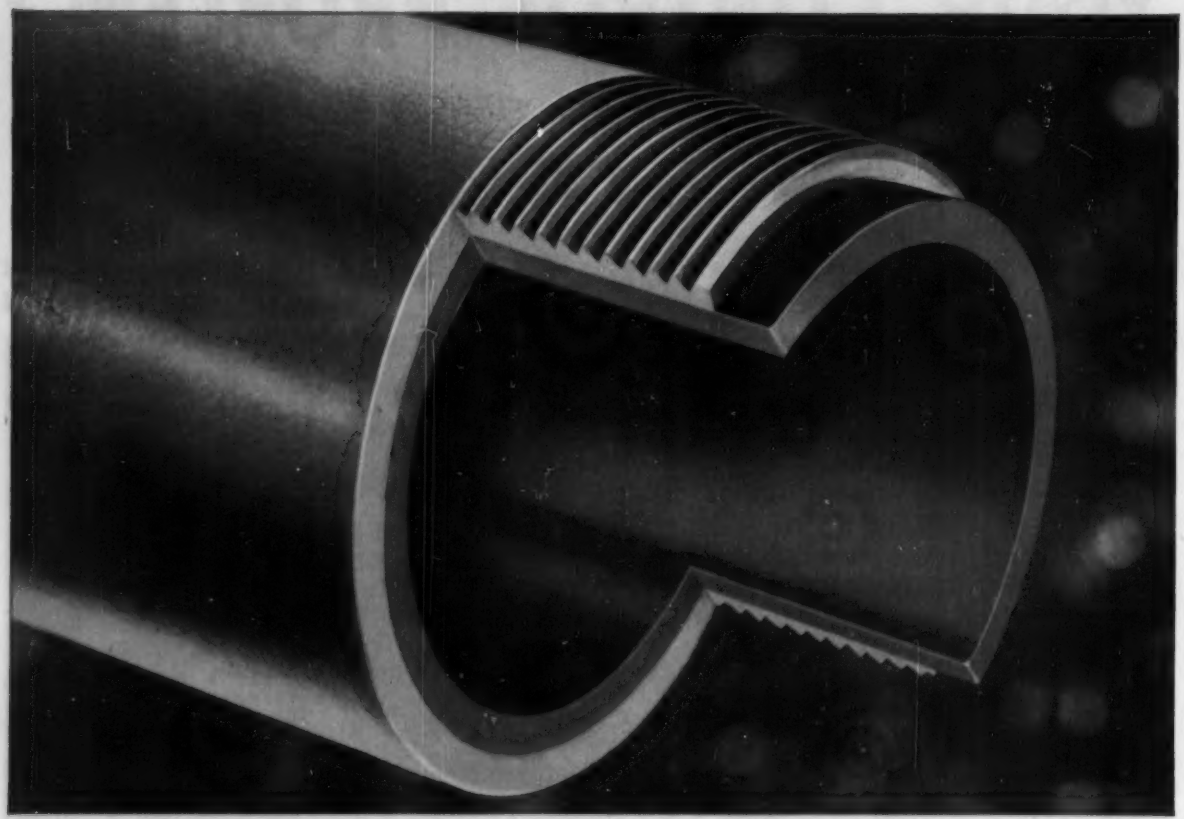
Contact the Cash Standard control specialist in your area or write Dept. A

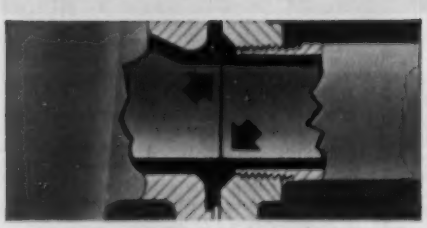
CASH C S **STANDARD**

A. W. Cash Co. and Its Subsidiary, Cash Standard Stacon Corp.
Dept. A, P. O. Box 551, Decatur, Ill.

PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS

DOW





Liquid never touches metal in saran lined pipe even at a flanged connection like this.

You can see why Saran Lined Pipe cuts corrosion costs

It's made of corrosion-resistant saran swaged into rigid non-bursting steel . . . liquid never touches metal in these installations

Here's your best way to convey acids, alkalies and other corrosive liquids—saran lined pipe, fittings, and valves. This modern piping is corrosion resistant . . . forms snug, leakproof joints . . . is available for working pressures up to 150 psi. Fittings and valves are also available in steel for working pressures to 300 psi.

Installation costs are low because saran lined pipe can be cut and threaded in the field with available pipe fitter's tools. Its rigidity means few supporting structures are needed.

Saran lined pipe has an outstanding record of trouble-free performance in many industries. THE DOW CHEMICAL COMPANY, Midland, Michigan.

Saran Lined Pipe Company
2415 Burdette Avenue
Ferndale 20, Michigan
Dept. SP626A-2

Please send me information on saran lined pipe, fittings and valves.

Name_____ Title_____

Company_____

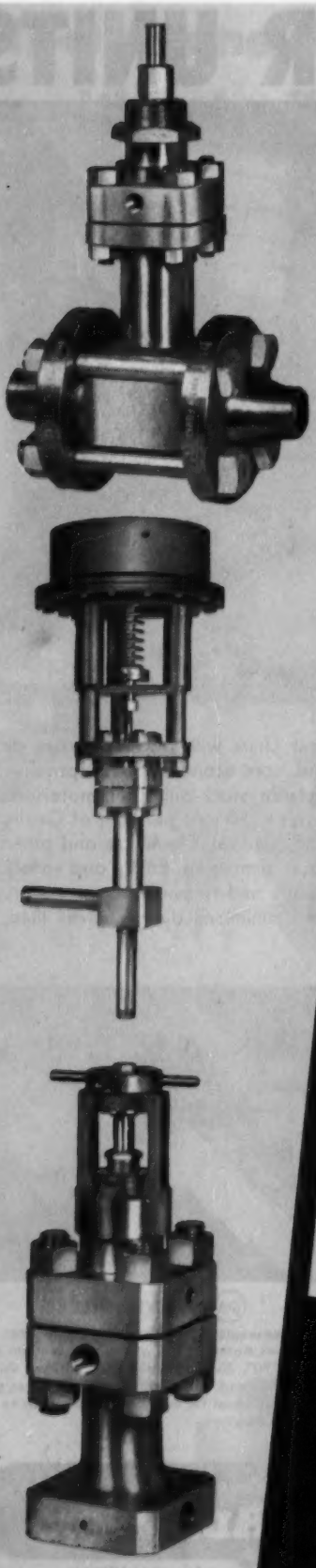
Address_____

City_____ State_____

Saran Lined Pipe is Manufactured by The Dow Chemical Company, Midland, Michigan.

you can depend on DOW PLASTICS

DOW



ANOTHER NEW IDEA FROM

FULTON SYLPHON

PACKLESS VALVES

YOU CONNECT AND FORGET

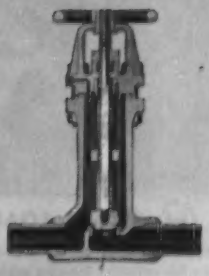
Some valves are good for severe corrosives, others for high pressures and temperatures, but these Fulton Sylphon Packless Valves are *complete* valves capable of mastering the toughest possible combination of conditions in atomic energy plants and grueling chemical processes. They assure utmost safety in handling hazardous materials, require no periodic maintenance, and practically eliminate down-time.

Typical of how Fulton Sylphon matches valve to process, these valves are made of stainless steel throughout, with the valve body machined as one unit from solid bar stock. And to prevent leakage or contamination, a SPECIAL SYLPHON® BELLOWS in multi-ply stainless steel forms a permanent, leak-proof seal for the stem. That is why they tame the severest corrosives inside and out. This is the reason, too, why these valves provide a high safety factor in high temperature-high pressure service.

These and other Fulton Sylphon Valves are available in many types, sizes, and metals—all with packless construction for greater safety, less maintenance and longer runs "on stream."

SEND TODAY FOR BULLETIN 813-VC

A SPECIAL SYLPHON BELLOWS which forms the permanent, leak-proof stem seal on all Fulton Sylphon Packless Valves offers four outstanding features. It is (1) cold-worked for greater resiliency and longer life, (2) seamless, without welded seams to break and leak, (3) formed in multi-plies for greater strength, and (4) made in the right metal for service requirements.



Mr. Controls

Robertshaw-Fulton

CONTROLS COMPANY

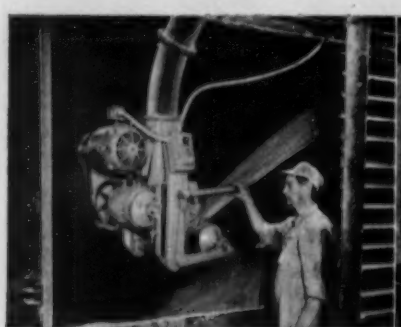
FULTON SYLPHON DIVISION · Knoxville 1, Tennessee

S-A CENTRIFUGAL ACTION THROWER UNITS

... HANDLE BULK MATERIALS FASTER, EASIER AND MORE ECONOMICALLY!

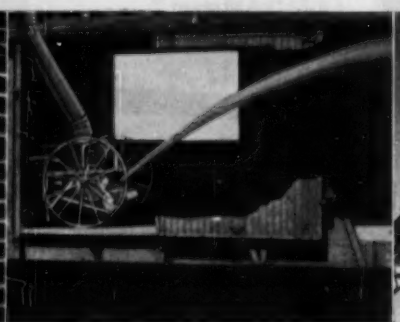
SAVES TIME, WORK and MONEY! IN STOCK FOR IMMEDIATE DELIVERY!

These powerful S-A Thrower Units will load box cars or storage bins fuller, faster and more economically... provide greater capacity in the outside stock-piling of materials. They will efficiently handle up to 150 tons per hour of Grain, Fertilizer, Crushed Ore, Sand, Gravel, Chemicals and other similar bulk materials up to 2" lump size. Easily and safely operated by one man... loads and trims in one operation. Improves working conditions, minimizes dust... saves time, work and money!



(S-A) SWIVEL LOADERS

Saves money with every car you load. Permits faster, full-capacity loading without hand trimming. Quickly and easily loads up to 150 tons per hour of practically any bulk material in sizes up to 2" lumps.



(S-A) BOX CAR LOADERS

This time-saving unit loads and trims in a fraction of the time required by hand methods. Operated by one man from the outside... safe from dust and accident. Handles up to 150 tons per hour of almost any type of bulk material.

(S-A) SWIVEL PILERS

Increases stock-pile capacity up to 10 times... throws materials in any direction over an arc of 270°. Eliminates frequent conveyor shifts. Quickly and easily throws up to 150 tons per hour... ideal for most bulk materials up to 2" lump size.

WRITE TODAY! For complete information on these time and money saving S-A Centrifugal Action Thrower Units!

STANDARD PRODUCTS DIVISION
STEPHEN S-ADAMSON MFG. CO.
3 Ridgeway Ave. Aurora, Illinois

There's one right way to buy pressure tubes—it's tube life per dollar: *Ask the experts!*

This month's report is on: **DM STEEL**

Has unusually high creep strength for a pearlitic steel, good stability up to 1200° F., fairly good corrosion and oxidation resistance. Has 2 to 3 times the life of carbon steel where corrosion is not severe. Recommended for cracking furnace tubes, hot oil lines, superheater tubes, high temperature steam piping and forgings for accessory parts.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

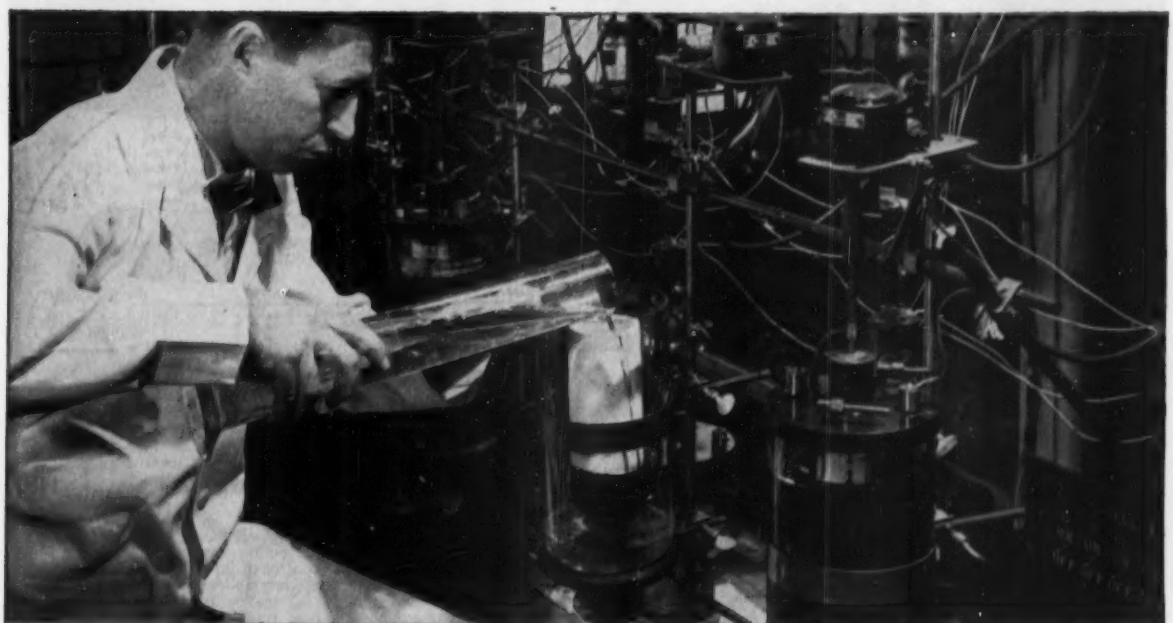
**Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

YOU'RE fortunate in having the Timken Company's large choice of high temperature tube steels that will solve your heat, pressure, corrosion and oxidation problems. You're even more fortunate when you choose the *one* analysis that will give you maximum tube life per dollar—the only true index to actual tube steel cost.

To find it, *ask the experts!*

These experts are the metallurgists of The Timken Roller Bearing Company. They'll put their more than 20 years of steel research and experience—with emphasis on high temperature steels—at your disposal. Help you select from 24 different analyses the one tube steel that will give you the best life/cost ratio. Regardless of which analysis you select, you'll be assured of uniform quality. Because the Timken Company rigidly controls quality from melt shop through final inspection.

Let the Timken Company's metallurgists help solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



Electrolytic equipment used in Timken Company laboratories to extract non-metallic inclusions from steels in research on steel cleanliness

YEARS AHEAD — THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

How the LINK-BELT Roto-Louvre dryer guards your product quality and cost control

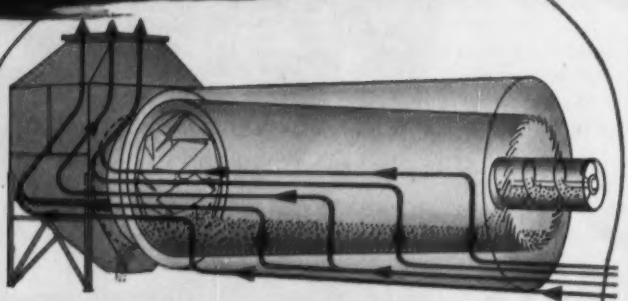
Roto-Louvre, shown in magnesium sulphate production, permits shorter retention time for material in drum . . . needs only half the floor space required by other designs.

Provides gentle pre-drying, drying or cooling with laboratory accuracy

THE dangers of overheating or degradation of your product make the drying cycle a key element of your quality and cost control system. Duplicate the pre-forming of your laboratory operation with a Link-Belt Roto-Louvre dryer.

This compact, highly effective machine introduces dry, heated air through ever-changing channels reaching the entire surface of every particle. Stratification and segregation—resulting in an irregular, overdried or underdried product—are prevented.

For a complete report on Roto-Louvre's remarkable efficiency, send for Book 2511. Or, if you prefer to send us a sample of your material, we can work out drying, cooling or roasting procedures you can duplicate in your own plant . . . using the right dryer from the broad Link-Belt line.



Common-sense design assures effective heat transfer

Roto-Louvre has largest volume of air penetrating thin bed of material near feed end, where greatest evaporation must take place. As material moves forward and bed becomes thicker, smaller air passages reduce volume of air passing through bed, preventing overheating. Precise control of input air temperature, exhaust and conditions of material travel assures maximum heat transfer per cubic foot of air.

LINK-BELT COMPANY
Prudential Plaza, Chicago 1, Ill.

Please send me 20-page Roto-Louvre Book 2511.

Name .....

Firm .....

Address .....

City ..... Zn.... State.....

LINK-BELT

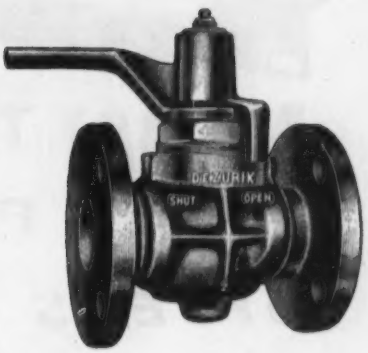
DRYERS • COOLERS • ROASTERS

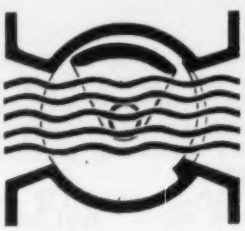
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World

14,233

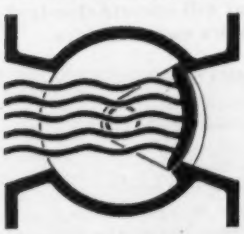
Only DeZurik

MAKES THE NON-LUBRICATED EASY-OPERATING PLUG VALVE with ECCENTRIC ACTION!





OPEN FULL



DEAD SHUT

DeZurik's exclusive principle guarantees easy operation and leak-free closure. The resilient-faced plug is eccentric in cross section, matching the eccentrically-raised body seat. When closing the valve, the plug turns freely until the face touches the seat. As the plug is turned aside in opening the valve, it is backed away from the seat, eliminating friction and wear without lubrication!

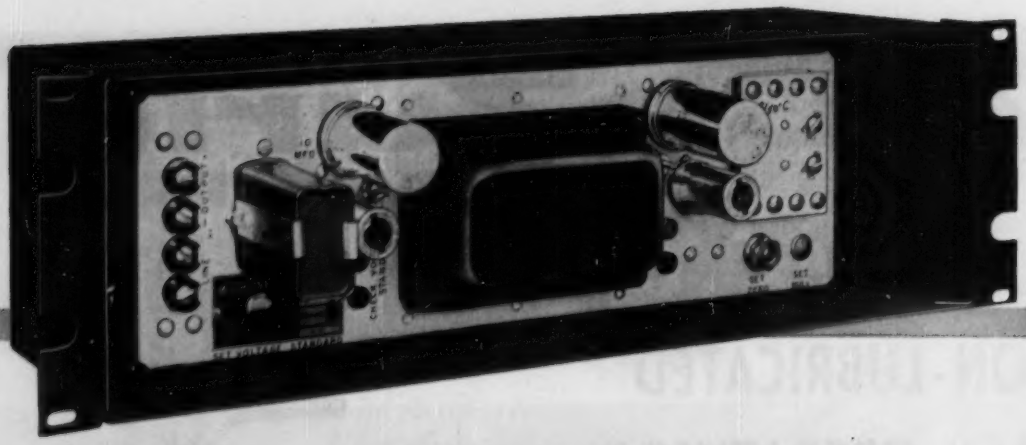
No other plug valve — no other valve of any kind — offers the unique advantages of DeZurik Valves.

Because they are non-lubricated, they can be used on any line without contaminating the flow! Because of their exclusive eccentric action, they close tight or open wide with a quarter-turn of the operating lever — without binding or sticking! Because of their resilient-faced plugs, they close drip-tight on any line despite solids in the flow!

Before you specify new or replacement valves, investigate DeZurik Valves — made only by

DeZurik
SHOWER COMPANY
SARTELL, MINNESOTA

DeZurik Valves are manufactured in sizes from ½" to 20"; in Iron, Steel, Bronze, Acid-Resisting Bronze, Ni Resist, Stainless Steel, Hastelloy, Monel, Nickel, Aluminum and other alloys. They are furnished with lever, gear, pneumatic, hydraulic or electric operators. Representatives in all principal cities or write Dept. E-11 for more information.



NEW TRANSMITTING POTENTIOMETER OFFERS 7 BIG FEATURES

★ **Extreme sensitivity. Responds to input change of 3 microvolts or less.**

★ **Self-contained continuous voltage reference. No standard cells.**

★ **No batteries or periodic standardization. Continuous accuracy without drift.**

★ **Simple circuitry. Only 2 single triode tubes.**

★ **Interchangeable range card. Ranges easily changed in the field.**

★ **No slide wires or choppers. Trouble-free operation.**

★ **Fast response: 0.04 second time-constant for 1000° F. span.**

The Series 184 Transmitting Potentiometer is the latest addition to the 'American-Microsen' System of Electronic Transmission and Process Control. With this new unit, it is now possible to measure and control thermocouple temperatures or the signals from such devices as pH amplifiers, gas analyzers, resistance thermometer elements, and other electrical systems.

The extreme sensitivity of the new Potentiometer, plus the high resolution and response speed of the 'American-Microsen' Control System, makes it possible to control process temperatures with the high accuracy required by present-day production demands.

The 0.5 to 5.0 ma. signal output can be transmitted 30 miles or more, over a single 2-wire circuit. In addition to 'American-Microsen' receiver, the signal will operate standard d-c milliammeter indicators and recorders.

OPERATING SPECIFICATIONS

Spans: 6 to 50 millivolts d-c.
Suppression: Up to 5 times span.
Output Signal: 0.5 to 5.0 ma. d-c.
Sensitivity: 0.003 millivolts (0.1° F.).
Repeatability: 0.02 millivolts. (0.6° F.).
Input Source Impedance: 200 ohms maximum.
Effective Input Impedance: 1000 ohms per millivolt of span.
Output Load Impedance: 3000 ohms maximum.
Speed of Response: 0.8 seconds for 99% response on 6 millivolt span. Speed increases with span.

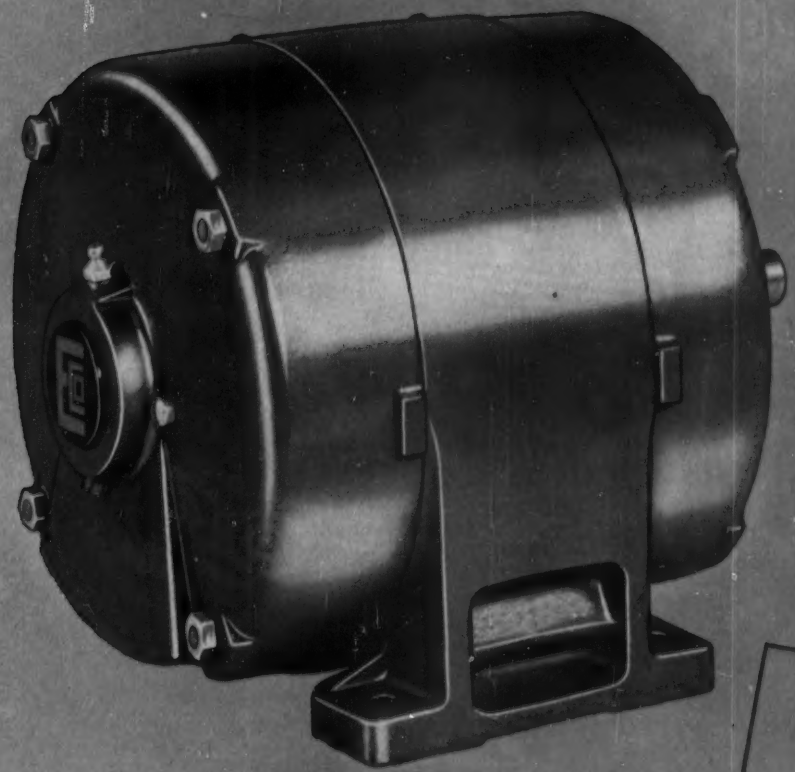
Write today for Bulletin MTT810.

MANNING, MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION, STRATFORD, CONNECTICUT

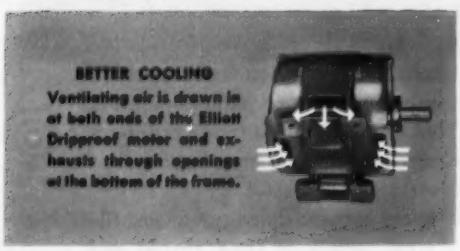
MAKERS OF THE 'AMERICAN-MICROSEN' TRANSMISSION AND PROCESS CONTROL SYSTEM, 'AMERICAN-MICROSEN' ELECTRO-PNEUMATIC TRANSDUCERS AND ELECTRO-HYDRAULIC CONTROL VALVE OPERATORS.

Inside and Outside . . . entirely new



the NEW Elliott C-W Dripproof Motor

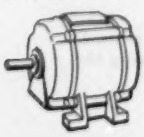
BALANCED DESIGN assures dependable performance


BETTER COOLING
Ventilating air is drawn in at both ends of the Elliott Dripproof motor and exhausts through openings at the bottom of the frame.

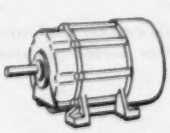
The *balanced* design of the new Elliott C-W type N motors provides the *best* in mechanical protection, the *best* in insulation, the *best* in bearings, the *best* in rigid construction. These motors produce more horsepower per pound, require less space, less maintenance, have longer service life. Every rotor is dynamically balanced. Rigid cast frames assure correct alignment, resist corrosion and mechanical abuse. Highly effective cooling eliminates troublesome hot spots.

The design illustrated above is drip-proof—and virtually splash-proof as well. Yet ingenious design has provided ample passages for cooling air. Other types of enclosures providing even greater protection are available for service where conditions are extremely severe.

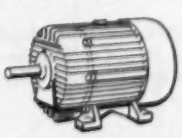
OTHER C-W TYPE N MOTOR ENCLOSURES



Totally-enclosed non-ventilated



Totally-enclosed, fan-cooled Frames 256 U and smaller



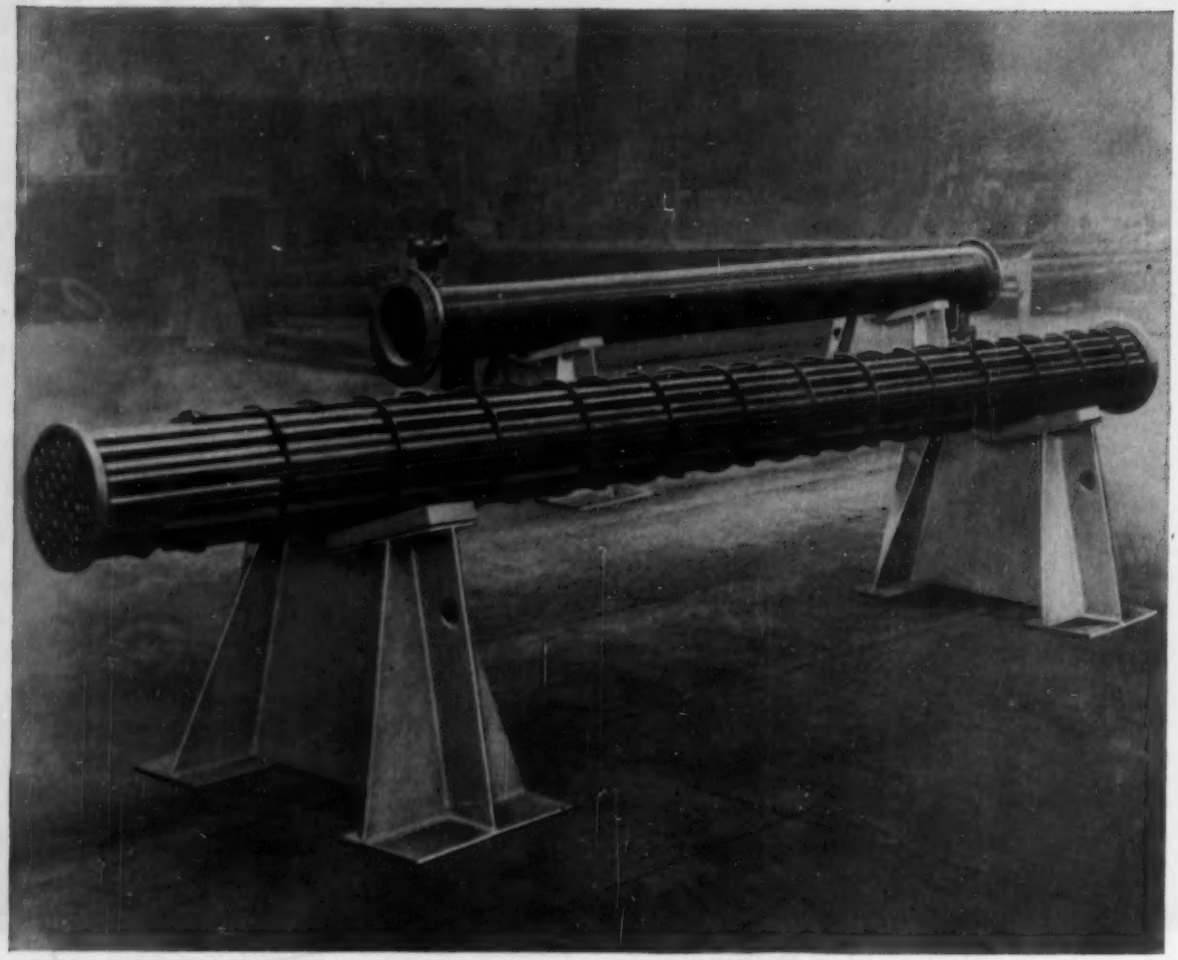
Totally-enclosed, fan-cooled Frames 284U-326U

ELLIOTT Company

CROCKER-WHEELER DIVISION

For complete details, send for new booklet. *WRITE* Elliott Company, Crocker-Wheeler Division, Jeannette, Pa.

W6-5



This heat exchanger—12 inch size and 16 foot tube length—was made by Struthers Wells. The seamless tubes in it were made from REM-CRU A-55 by The Babcock & Wilcox Company, Tubular Products Division.

TITANIUM...strongest defense against NaOCl attack

Wyandotte Chemicals engineers faced extreme corrosive conditions in processing sodium hypochlorite. A large heat exchanger was involved . . . so down-time and cost of frequent replacement was a serious problem.

Tubing of REM-CRU A-55 was chosen over less expensive, less corrosion resistant metals because of titanium's proven ability to last many times longer in severe environments. While previous installation life was measured in months, the new titanium heat exchanger tubes should last for years.

Wyandotte Chemicals' experience underlines a fact that may be worth money in your plant: the price of a material of construction is not nearly so important as the cost per service year of operating equipment. That's why titanium frequently pays its way . . . in longer service, less maintenance, less down-time losses.

REM-CRU offers prompt delivery of versatile titanium in a wide variety of sizes, shapes and grades—including new high-strength weldable alloys. REM-CRU engineers will be glad to help with problems of application or fabrication.

To keep abreast of the latest developments on this vital metal, write to Dept. C-11 for the Rem-Cru Review—a free periodical presenting the latest technical data on titanium alloys.

REM-CRU TITANIUM

REM-CRU TITANIUM, INC., MIDLAND, PENNSYLVANIA

Sales Offices: 3338 South Malt Avenue, Los Angeles 22, California • 4501 W. Cortland Street, Chicago 39, Illinois • 405 Lexington Avenue, New York 17, N. Y.

from abrasive slurries to delicate foods . . .

MOYNO® PUMPS

CUT HANDLING COSTS

The Moyno "progressing cavity" pumping principle has enabled thousands of plants to pipe difficult materials that were transported by hand and other expensive means. Moyno is the only pump that can handle many abrasives, pastes, slurries, chemicals, foods, suspended solids, etc., without foaming, aerating, crushing or excessive pump wear.

As shown above, Moyno Pumps have a screw-like rotor that revolves in a double threaded stator creating progressing cavities which smoothly move material through the pump. They will pump anything that will move through a pipe . . . even plaster and non-pourable pastes!

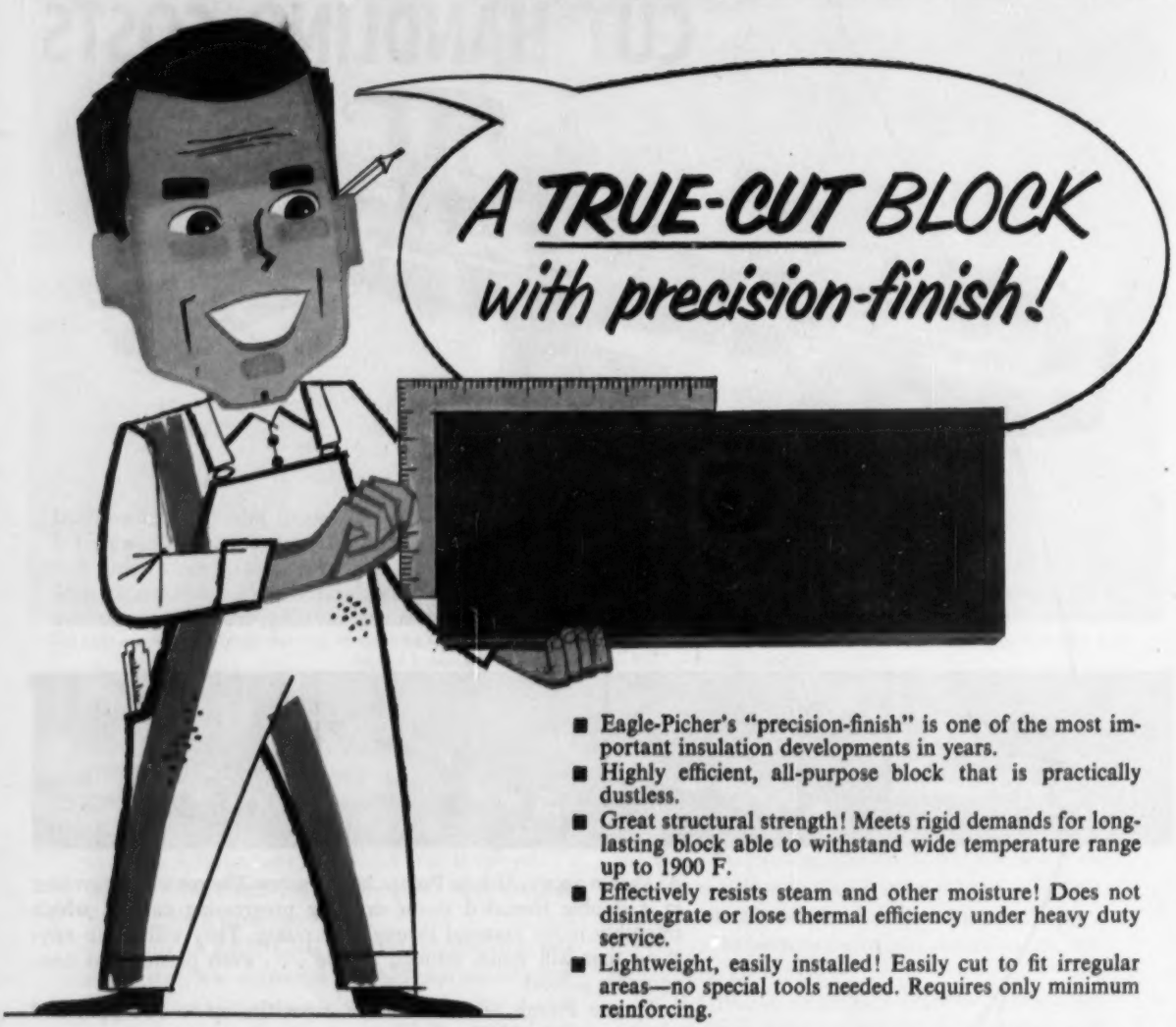
Moyno Pumps are available in capacities up to 500 gpm and pressures up to 1000 psi.

Examine your processing methods. No doubt there are several places where Moyno Pumps can drastically cut costs. Ask us, we'll give you a frank answer. Send us an outline of your problem today! Write for Bulletin 30-CE

ROBBINS & MYERS, INC.

SPRINGFIELD, OHIO | BRANTFORD, ONTARIO

EAGLE-PICHER
PV SUPERTEMP
BLOCK INSULATION



- Eagle-Picher's "precision-finish" is one of the most important insulation developments in years.
- Highly efficient, all-purpose block that is practically dustless.
- Great structural strength! Meets rigid demands for long-lasting block able to withstand wide temperature range up to 1900 F.
- Effectively resists steam and other moisture! Does not disintegrate or lose thermal efficiency under heavy duty service.
- Lightweight, easily installed! Easily cut to fit irregular areas—no special tools needed. Requires only minimum reinforcing.

FREE SAMPLE! WRITE TODAY! You'll sell yourself on the new "precision-finish" once you compare Eagle-Picher PV Supertemp Block to other insulating blocks.

(Member of Industrial Mineral Fiber Institute)

Since 1843

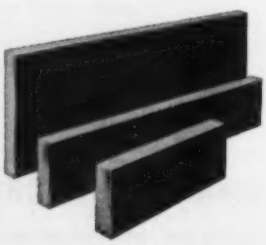
EAGLE EP PICHER

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

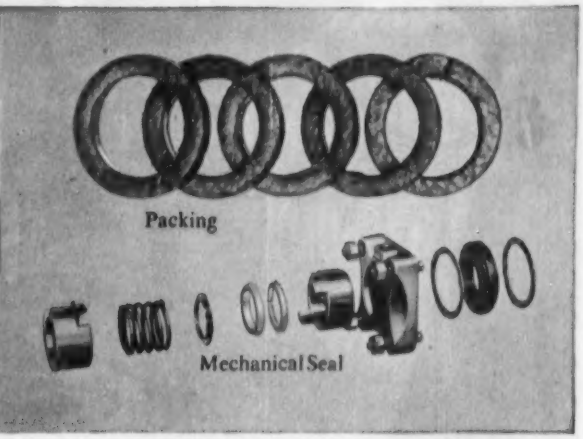
Mineral wool, magnesia and other insulations for all temperatures from below 0 F. to over 2000 F.

(Conforms to Commercial Standard CS 117)



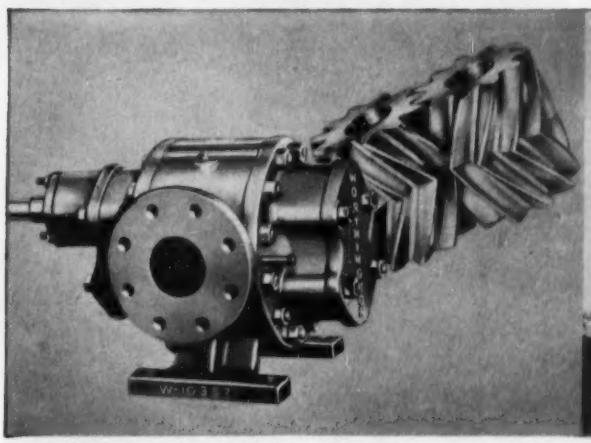
WHAT'S YOUR P.Q.?*

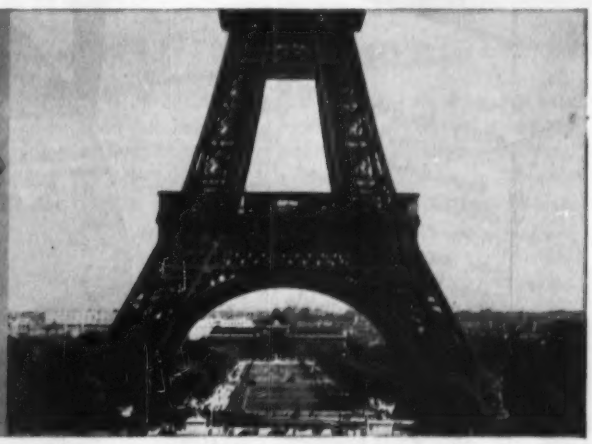
*PUMP QUOTIENT



Pump standardization—how do you benefit? By standardizing, you can often drastically cut your spare parts inventory. With Worthington's SESC (Standard End Suction Centrifugal) line, you are also assured of immediate delivery from factory or distributor stocks. Because the SESC line consists of standardized "parts" not "pumps," it can be built in many different combinations . . . 70,480 to be exact. For all these reasons, more and more companies are turning to SESC pumps. See bulletin W-300-B4.

Packed stuffing box or mechanical seal—which is preferred? Each has its applications. Mechanical seals are gaining in popularity year after year. With Worthington's Standard End Suction Centrifugal pumps you not only get your choice of mechanical seals—or packing—but you can easily convert from one to the other using standard stock parts. This "interchangeability" is just one of the many extra advantages of Worthington's SESC line. For more details write for bulletins W-300-B4 and W-350-B16.





Which pump is best for difficult suction conditions? Worthington's close-clearance rotary pump is self-priming and can operate under vacuums as high as 28 inches of mercury. The large unobstructed suction opening in this herringbone gear pump permits operation with thin or viscous liquids at high efficiency. The double-helical gears balance all end thrust, eliminate trapping of liquid between gear teeth and provide a quiet, pulsation-free flow at high speeds. For the full story, ask for bulletin W-483-B2.

Whose pumps would you expect to find in the Eiffel Tower? If you said "Worthington's," your P.Q. is all right. The original steam-driven pumps that power the Eiffel Tower's 100-passenger hydraulic elevators were built by Worthington back in 1889. The most recent additions, modern electric-drive Worthington pumps, moved into the Tower just last year. Today as then, wherever men must move liquid, they turn to the company with a reputation for performance. Worthington Corp., Harrison, N. J. PG. 6.6

WORTHINGTON

Spotlight on Quality...

WELDCO Quality

Because WELDCO Pipe and Tubing Are Made With the Exclusive Double-Fusion Welding Process

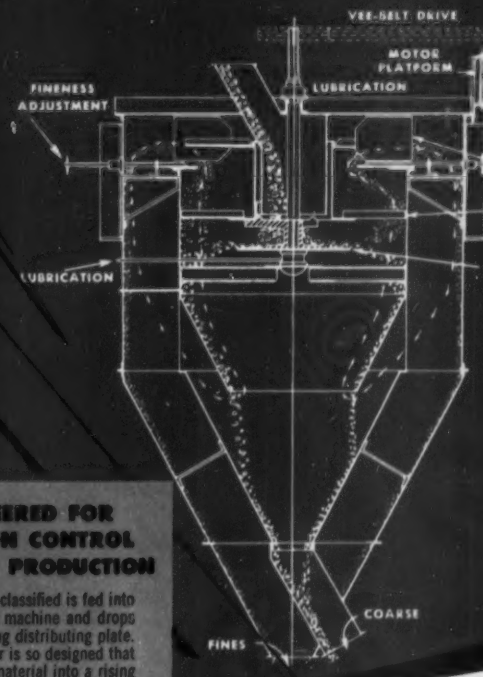
In every length of WELDCO Tubing, you get quality, uniformity, dependability . . . because WELDCO is produced by specialists—men who have the experience, equipment and facilities to make Pipe and Tubing to your exact specifications.

WELDCO is available in Stainless Steel, Monel, Inconel, Nickel, Cupro-Nickel, and Hastelloy . . . in Tube and Pipe sizes from 3" to 30", Schedules 5, 10, 40, and 80. For special problems, or regular applications, always specify WELDCO and be sure of getting top-quality, dependable products!

WELDCO

Whatever Your Needs In Tubing . . . You're 'Way Ahead With WELDCO

THE YOUNGSTOWN WELDING & ENGINEERINC CO. · 3724 Oakwood Ave., Youngstown 9, Ohio

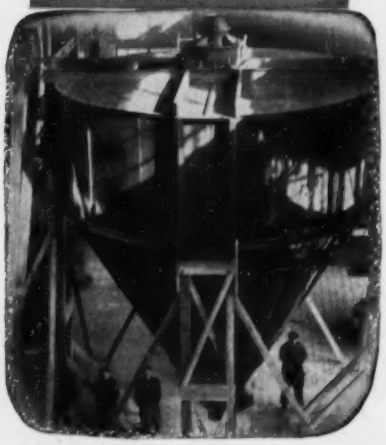


More Accurate Sizing Of Ground And Pulverized Materials!

ENGINEERED FOR PRECISION CONTROL AND HIGH PRODUCTION

Material to be classified is fed into the top of the machine and drops onto a revolving distributing plate. This distributor is so designed that it sprays the material into a rising air current which entirely surrounds the plate. The finer particles are lifted by the air stream and the coarse particles drop down to the reject spout. Passing up through the separating chamber, the dust-laden air is given a whirling motion between Spinner blades and any remaining oversize particles are precipitated. The separator is adjustable to control the fineness of the finished product with unusual accuracy.

WILLIAMS MECHANICAL AIR SEPARATORS For Finenesses From 30 to 325 Mesh



18-Foot Williams RC Separator being tested at plant before shipment.

- Most efficient mechanical air separator ever developed for classifying ground and pulverized materials, or for removing fines from dry ground materials before classifying.
- Product quality is vastly improved and output considerably increased when operated in closed circuit with virtually any type of mill.
- Will handle with equal efficiency a complete range of products—mineral, chemical and vegetable—from the hardest, most dense limestone and ore to the softest, fluffiest starches and flours.
- Permits coarser settings in grinding equipment thus lengthening equipment life by reducing wear on all moving parts. Power consumption is much lower.
- Extra heavy construction. Equipped with anti-friction bearings encased in dust-proof and moisture-proof housings. All casings are of heavy steel plate construction. Operation is dustless and repair cost is practically nil, since there are no fine sieves to wear out and the heavy construction insures long life.

9 Standard sizes, 2½ to 18-foot diameters — Capacities from 500 lbs. to 75 tons hourly

Write For Details And Describe Your Operation

WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 NORTH NINTH • ST. LOUIS 6, MO.

WILLIAMS

CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

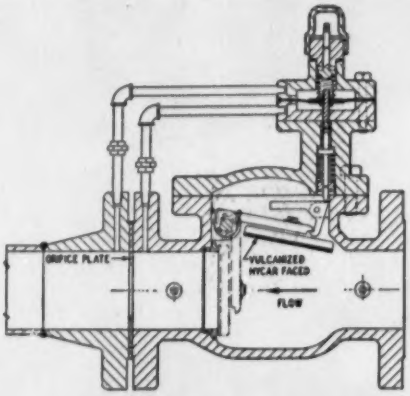
The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

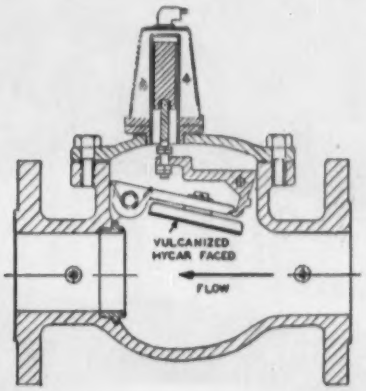
Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.

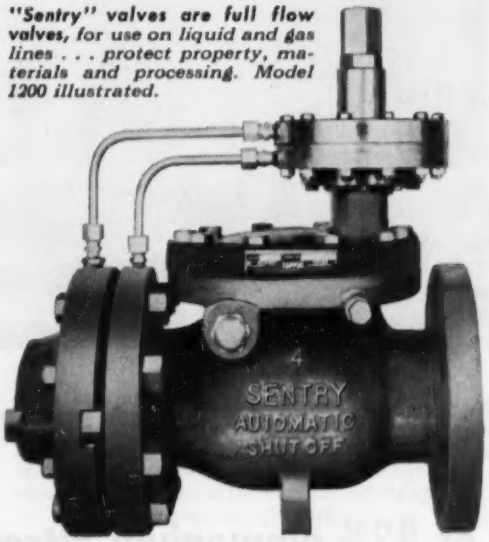


Model 1200. "Sentry" **excess flow valve** *automatically and instantaneously shuts off when the rate of flow in the line exceeds a predetermined rate.*

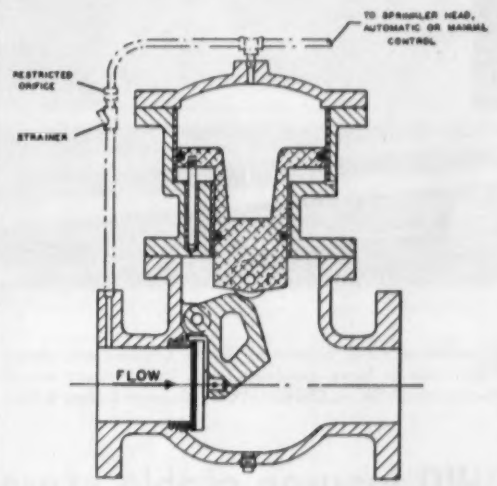


Models 1700 and 1800 "Sentry" **solenoid shut-off valves** *operate by remote electrical control automatically and instantaneously. In Model 1700, solenoid is energized, in Model 1800 solenoid is de-energized to maintain flow.*

"Sentry" valves are full flow valves, *for use on liquid and gas lines . . . protect property, materials and processing. Model 1200 illustrated.*



Other types "Sentry" Valves: high-pressure and low-pressure and over temperature shut-off valves available.



Model 3000 "Sentry" **piston operated quick-opening valve** *opens instantaneously when the pressure above piston is released. Ideal for deluge systems — and for remote opening and closing of fuel line.*

Now Coppus brings you "Sentry"℠ Valves for automatic protection

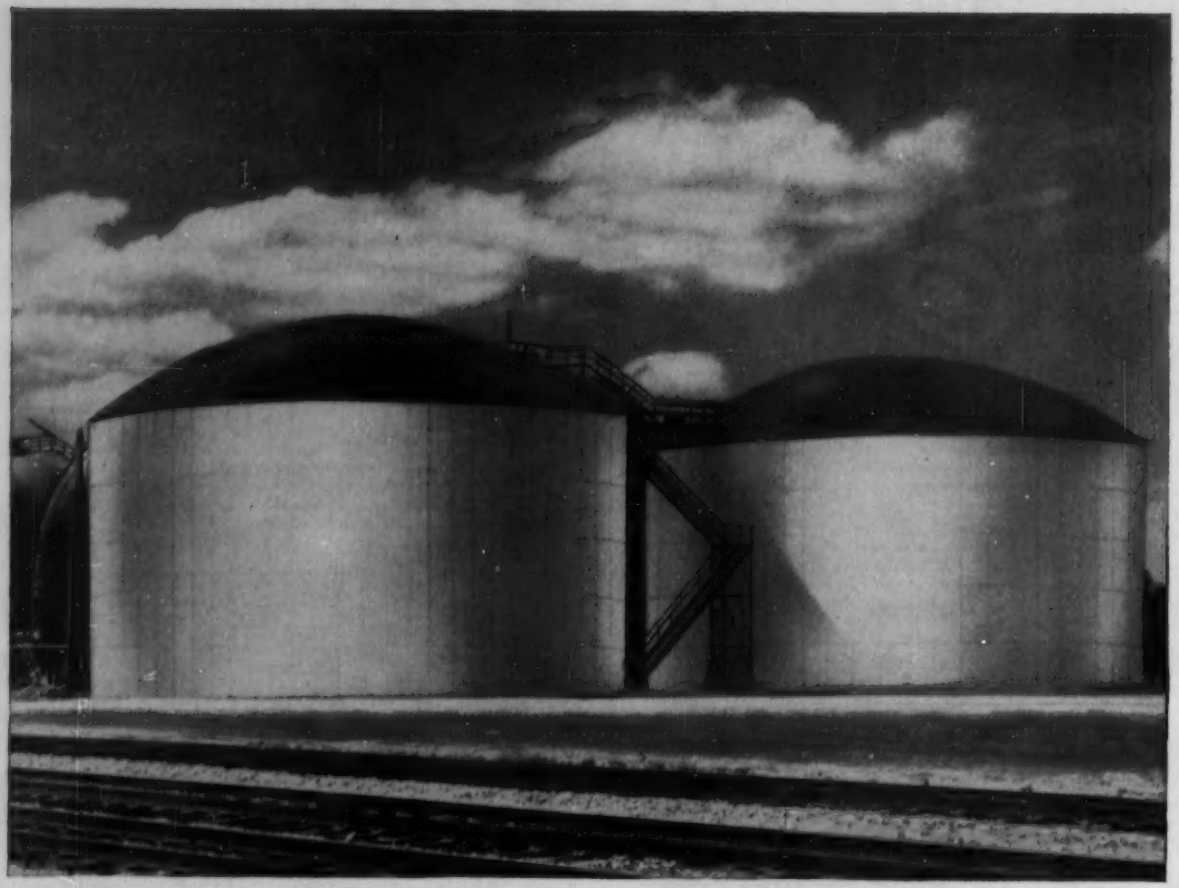
These valves are *patented* quick-closing latch type and quick-opening piston type. All are full flow valves.

Latch-type "Sentry" valves are widely used in the chemical, petroleum and gas industries for closing automatically and instantaneously gas, process and fuel lines. The piston type valve can be automatically or manually opened and closed from any remote location. It is ideal for deluge systems, operates instantly; closing of this valve is against the flow, eliminating water hammer.

Sizes run from 1½" to a full 8". For full information send for Coppus Bulletin 500 to Coppus Engineering Corporation, 231 Park Avenue, Worcester 2, Massachusetts.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

LOOK FOR THE BLUE BAND THAT IDENTIFIES COPPUS QUALITY



35,000 barrels of 83% ammonium nitrate solutions are stored without corrosion in these aluminum tanks. Development was a joint effort between **Sohio Chemical Co., Chicago Bridge & Iron Co.,** and **Aluminum Company of America.** Alcoa Aluminum Alloy 5052 is used for sidewalls in thicknesses up to 1⅜". The consumable electrode process was used for all welding.

SOHIO insures stable storage of 83% ammonium nitrate with two 35,000 barrel tanks of ALCOA ALUMINUM

Aluminum will not render ammonium nitrate unstable! That's why Sohio Chemical Company chose Alcoa® Aluminum for two special 35,000 barrel tanks used to store 83% ammonium nitrate solutions produced in a new $17-million petrochemical plant at Lima, Ohio. Now in full-scale production, the plant yields over 300,000 tons of ammonia and derivatives yearly.

Like so many other petrochemical producers, Sohio has found that Alcoa Aluminum provides an ideal answer to the problem of better, cheaper storage and handling of ammonium nitrate and nitrogen solutions. And the superior corrosion resistance of aluminum gives it extra-long service life under constant exposure to chemicals and plant atmospheres normally corrosive to most metals. That makes Alcoa Aluminum the least expensive material to solve storage and handling problems when product protection and corrosion resistance are vital.

The superior storage and handling performance of Alcoa Aluminum has been proved on-the-job in such diverse applications as these: fertilizer solution storage tanks, nitrogen chilling exchangers, prilling towers, tank cars, piping and drums. A new Alcoa book, *Process Industries Applications of Alcoa Aluminum*, contains 80 pages packed with performance and design data. To get your *free copy*, write to Aluminum Company of America, 903-L Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Two Separate Circuits Mean Reliable Rectifier Operation

ALLIS-CHALMERS

Mercury Arc Rectifiers

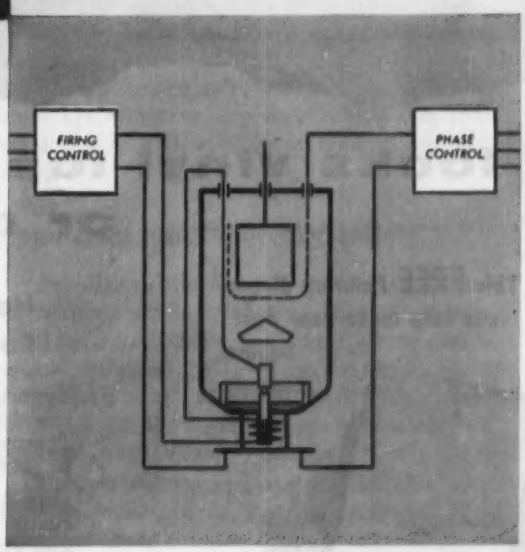
One of four metal-enclosed assemblies in a midwestern installation with a total capacity of 15,000 kw at 620 volts, dc.

1. Firing Circuit

A small dc excitation arc is automatically ignited only once, when the unit is started. It is then maintained on the mercury cathode of each rectifier tube. It offers advantages similar to a pilot light. Since it is far easier to maintain an arc than to start it, this feature reduces the chance of the excitron losing excitation during power supply disturbances.

2. Phase Control Circuit

A separate circuit utilizes the deionizing grid to obtain phase control. Grid-type phase control permits operation in the clean region near the anode where ion density is lowest, instead of on the surface of the cathode mercury pool where there is turbulence and contamination. Reliability of phase control does not depend on the condition of the mercury. This is an exclusive excitron feature.



Only Excitron Rectifiers Provide Separate Circuits

for these two all-important functions. Improved operation results — one function is never sacrificed for the other — you get optimum operation from each.

For Complete Information on rectifier operation, call your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5136

TYGORUST—

locks vinyl top coats to damp or dry rusted steel

This FREE Painting Manual can help make your fight against corrosion easier

Contains a wealth of practical data in its many sections: how to simplify surface preparation; what top coating to use for over one hundred corrosive conditions; how many coats; how to maintain coatings in good condition; common spraying troubles and how to remedy them. It's free on request. Ask for the Tygon Painting Manual.

- ***Holds surface preparation to a minimum***
- ***Can be top coated within an hour***

Tygorust Primer licks the big problem in using vinyl-based protective coatings: **Adhesion.** Not only does Tygorust assure a well bonded top coat to the steel it is to protect, but it does it economically.

Forget sandblasting. Tygorust actually works better on rusted surfaces. Just wire brush loose or flaky rust and apply Tygorust. The steel can be dry or damp — it makes no difference. (You can brush or spray Tygorust on dry steel—damp steel should be brushed.) Use Tygorust on concrete, too.

You can overcoat Tygorust with any finish material; but for real corrosion-resistance, make the finish coats Tygon—the corrosion-resistant paint that has stood the test of time.

Plastics and Synthetics Division

U. S. STONEWARE

AKRON 9, OHIO

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· Chementator

H. T. SHARP

√ **Pullman Co. reveals that its M. W. Kellogg subsidiary hasn't yet decided whether or not to exercise its license for the Phillips' polyethylene process. Reportedly, a heavy forfeit must be paid if a plant isn't built by early 1958.**

√ **Phillips Chemical is wrapping up pilot studies on a co-polymer of ethylene and another olefin (likely propylene). Commercialization looms.**

√ **Nitrogen dioxide and other nitrogen compounds can be made quickly and cheaply by exposing hot compressed air to radiation from uranium-235. Rensselaer scientists see their new process as an easy route to nitric acid.**

√ **Anaconda will build a $1-million pilot plant to study its new alumina-from-clay process.**

New titanium process under study

A new fused-salt process for electrolytic production of high-purity titanium and titanium boride is now being studied at the University of Washington. Developed by R. W. Moulton, the new process has made laboratory amounts of over-99.0%-pure metallic titanium. And the main impurity is oxygen, no carbon or nitrogen is present.

Using various ratios of K_2TiF_6, KCl and KBF_4, Moulton has made several combinations of titanium and boron at current efficiencies as high as 60%.

Much work remains to be done to set optimum melt ratios, operating variables and costs. (For example, B_2O_3 used in place of KBF_4 might prove more economical.) Even at this stage, however, the researchers feel that production of TiB_2 appears to hold commercial promise.

Japan tries novel mercury cell

Paralleling the footsteps of the Germans, but trailing them by better than a decade, Japanese researchers have now developed a vertical, rotating-cathode, mercury cell. First commercial unit, a single 20,000-amp. cell, turns out 20 tons of sodium hydroxide per month at Asahi Glass' Yodogawa plant.

Though belated, and now only in the cradle stage when compared to the Germans, Japanese activity is running much hotter. They're also developing the cell for applications other than brine electrolysis.

• Kanegafuchi Spinning Co. is studying the recovery of NaOH from waste sodium sulfate via a 2,000-amp. cell.

• Fuji Iron & Steel has produced sodium phenolate with a 200-amp. pilot cell.

On the other hand, the Germans, who had full-scale plants on stream even during the war (*Chem. Eng.*, Jan. 1946, p. 113), are turning cool toward the vertical cell. Development and expansion have slowed over the past

decade. Their biggest plant, Chemische Werke Huels' operation at Marls, has 190, 36,000-amp. units producing 5,500 tons/mo. of Cl_2, but it's added only 20 cells in the past ten years. Major reason for the waning enthusiasm: High capital cost.

Japan's interest in the vertical cell is spurred mainly by fast-rising costs of plant space and labor. The cell saves both.

Asahi's unit takes up some 25% less floor space than a horizontal cell making an equal amount of caustic. Compared on chlorine production basis: The rotating-cathode cell yields 0.6 ton/sq. ft., the conventional cell 0.1 ton/sq. ft. And the vertical cell is said to be simpler to operate and maintain.

Operating costs of a full-scale installation would run 30% under the present plant, Asahi figures. But it agrees with the Germans that capital costs would climb—to about 2.5 times that of a conventional unit.

This dampens plans for immediate full-scale commercialization. But development work continues since Asahi expects labor and land costs to be high enough to justify use of vertical cells before long.

Asahi's rubber-lined, steel cell measures 8¾ ft. high, 6½ ft. wide and 6½ ft. long, takes 1,625 lb. of mercury. Six graphite anodes fit between five cast-iron circular cathodes. Purified brine feeds in above the level of the mercury.

Cathodes rotate through mercury bath and carry a mercury film into the brine. Amalgam formed is wiped off the cathodes when they rotate through the mercury again, and pumped to a graphite-packed denuding tower for hydrogen and caustic soda recovery. Depleted brine and chlorine overflow are separated to recover the Cl_2.

Fueling a boom with KOH

Dow Chemical is now installing a battery of mercury cells (of its own design) at its Pittsburg, Calif., plant to triple its caustic potash capacity. Dow's expansion, due to be completed early next year, is the latest symptom of the ever-quickening swing to heavy-duty liquid synthetic detergents (*Chem. Eng.*, Sept. 1956, p. 275).

These detergents are based on tetra potassium phosphate instead of the tetra sodium phosphate used in other type of cleaning agents because TPP is more soluble, can pack more cleaning power into the product. But to make TPP for this use requires high purity KOH—most readily made by the mercury cell technique.

Right now, output of mercury cell KOH is a relatively small part of total potassium hydroxide production. But it's growing fast and will continue to grow with the rapidly expanding liquid detergent market (now about 10% of the total synthetic detergent market). And at least one major soap firm says firmly, "We're betting much of our future growth on the liquid synthetics."

You can bet that other KOH capacity hikes will follow Dow's move in the months ahead.

Two more reduce iron ore in fluid beds

Two more fluidized-solids processes for direct reduction of iron ore have joined the method developed jointly by Hydrocarbon Research, Inc., and Bethlehem Steel (*Chementator*, May 1956, p. 110) in bidding for steel industry interest.

U. S. Steel now has a direct-reduction pilot unit running at its Chicago works and is now studying the process cost picture. And a process developed by MIT's Warren K. Lewis is being pilot-planted by Arthur D. Little, Inc., Cambridge, Mass. The latter is said to be the only completely continuous process for direct reduction of iron ore.

Unlike the HRI-Bethlehem process which uses pure hydrogen, relatively low reaction temperature (about 900 F.) and relatively high pressure (about 400 psi.), both USS and Lewis operate at high temperatures (1,100-1,700 F. and 1,380-1,740 F. respectively) and much lower pressures.

USS uses hydrogen as the reducing agent, but it has also explored the use of mixtures of hydrogen and carbon monoxide (U. S. 2,752,234).

Lewis' patent (U.S. 2,711,368 assigned to Esso Research and Engineering) describes the basic process now being tried at ADL. Methane is the reducing agent in a multistage operation. Methane and air enter the process at one end, Fe_2O_3 and metallic iron enter at the other. The methane, and some CO and H_2 formed by methane cracking in the chamber, reduces the Fe_2O_3. Exit stream contains 70-95% Fe and 5-30% FeO by weight. Though not a true sponge iron, this mixture is an excellent feed for the open hearth.

Work proceeds and *Chemical Engineering*

(Continued on page 108)

Another client benefits from a Badger "Precious Plus"

An Achievement of Creative Engineering:

STYRENE FROM GASOLINE!

Sketch shows Cosden Petroleum's new ultra-fractionation and styrene manufacturing plant as it will appear when completed in early 1957. The four columns — each almost 200 feet high —will be among the tallest ever erected!

The plant that "couldn't be built" now under construction

At Cosden's Big Spring, Texas, refinery, Badger is erecting the first plant ever designed for the recovery of ethyl benzene by distillation. The process *first* became commercially practical when Badger Engineers developed Ultra-fractionation.

Now, instead of marketing catalytic reformer effluents as mixed solvents, this new distillation process will make it possible for the client to produce a pure product with a far higher profit margin.

This achievement in *Creative Engineering**, like all intangibles, can never be shown on the blueprints. Yet it is the "Precious Plus" in Badger's performance that is making Cosden's plant possible!

Other leading companies, too, find Badger's *plus* in performance of precious advantage — whether their need is design, engineering or construction. How else explain the unusual growth Badger is enjoying?

+ You need new "yardsticks" to measure the plus performance of Badger. For the abilities of this dynamic organization go far beyond what can be shown on blueprints—and it's such intangibles that add up to better processes and plants, faster and at lower cost.

***Creative engineering** . . . whether your process problem is common or complex, Badger engineers solve it with fresh thinking that frequently produces new efficiencies, unexpected savings.

Broad experience . . . Badger Engineers are more than competent—most staff members are recognized authorities in their fields.

Key Man operation . . . the Badger man who submits your proposal is always a principal—always the Key Man responsible for the execution of your job. Clients say, "This is the Badger difference that makes the difference."

BMC

BADGER MANUFACTURING COMPANY

230 Bent Street, Cambridge 41, Massachusetts
60 East 42nd Street, New York 17, New York
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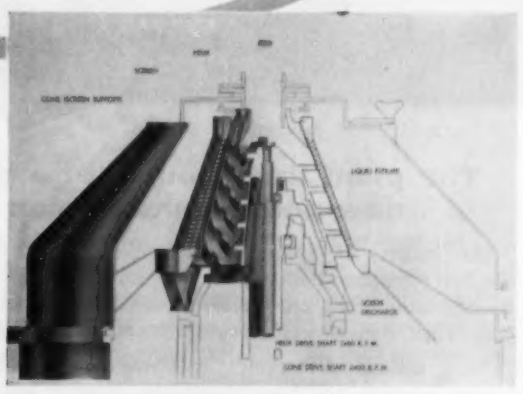
ENGINEERS • CONTRACTORS • DESIGNERS • MANUFACTURERS

CENTRIFUGAL FORCE . . .

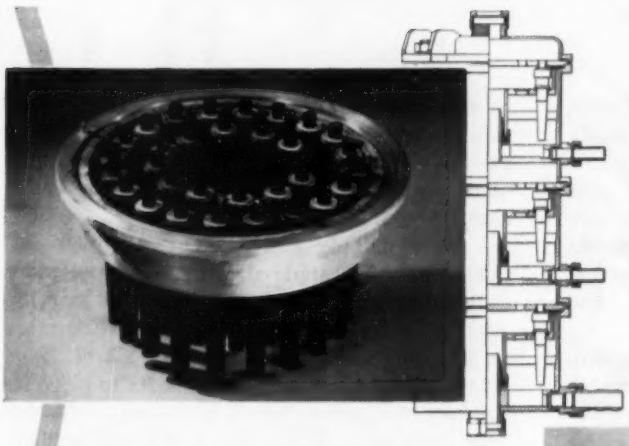
Important Tool for the Process Industries

Continuous processing requirements in the Chemical Industries have placed an ever increasing emphasis on centrifugal force. Rounding out an existing line of equipment, Dorr-Oliver is now marketing the products of the Merco Centrifugal Company which was consolidated with Dorr-Oliver on February 1st of this year. The tried and tested Merco Centrifugal Separator and the new Mercone Centrifugal Screen can now be teamed up with a wide variety of DorrClone Classifier designs to meet any wet processing problem where the use of centrifugal force is indicated.

The Merco Centrifugal Separator . . . a continuous, versatile centrifuge for microscopic particle segregation down to 1 micron, for washing and concentration or for soluble recovery. Features built-in hydraulic hoist, overhead bearing and stainless steel rotor and housing. Bulletin No. 4051.

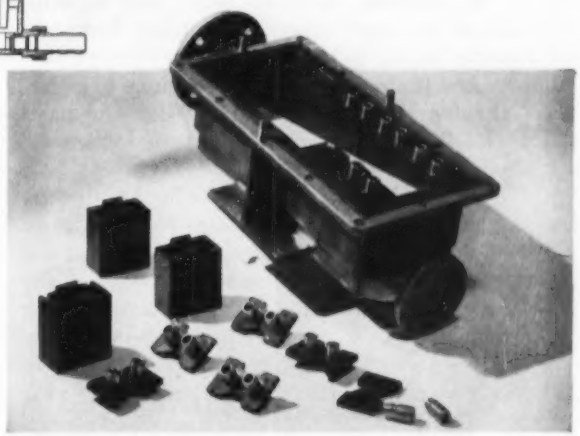


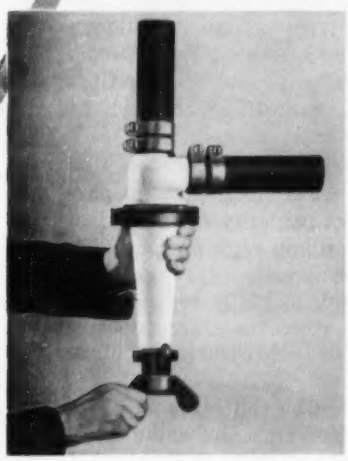
The Mercone Centrifugal Screen . . . a new unit combining the outstanding features of a centrifuge and a screen. Operation is completely continuous permitting large throughput capacity. Cyclo drive operates screen and helix at positive differential speeds . . . solids are conveyed along the screen and discharged in a dry state. Bulletin No. 1555.



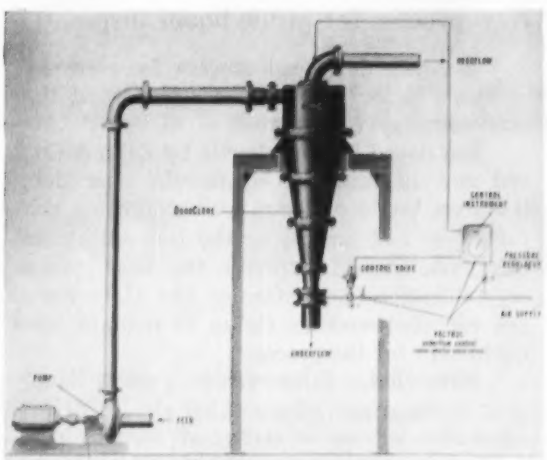
The TM DorrClone . . . combines number of 10 or 15 mm dia. cyclones in a common housing with all cyclones in each stage operating in parallel. Up to three stages can be incorporated in a single unit for separations in the order of 2-3 microns. Bulletin No. 2502.

The M DorrClone . . . Combines molded rubber block cyclones in diameters of 30 and 50 mm installed in a common housing. Type M-30 (containing twenty 30 mm dia. units — illustrated at right) separates at 8-10 microns and Type M-50 (containing ten 50 mm dia. units) at 15-20 microns. Bulletin No. 2504.





The P-50 DorrClone . . . a 50 mm dia. wet cyclone constructed entirely of porcelain. Capacities vary from 7.5 GPM at a feed pressure of 7.5 psi up to 30 GPM at 80 psi. Leaflet No. 2505.



The FR DorrClone . . . a completely rubber lined wet cyclone in diameters of 6″, 12″ and 24″. Features a fixed feed opening and varying vortex finder and apex openings. Capacities vary from a lower limit of 50 GPM for the 6″ unit to 1550 GPM for the 24″ unit. Average separations range from 25 microns in the 6″ to 60 microns in the 24″. Bulletin No. 2503.

Illustrated on these pages are several of the designs Dorr-Oliver has used to harness centrifugal force for the process industries. Only by carefully analyzing the problem can the correct unit specifications be determined. Any or all of the bulletins listed are free on request. When writing we suggest you include a brief outline of the particular application you have in mind. Dorr-Oliver Incorporated, Stamford, Connecticut.

DorrClone, Merco and Mercone TM Reg. U. S. Patent Office

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will have a detailed description of the Lewis process and ADL's pilot plant in an early issue.)

Steel industry people, mindful of past failures with direct-reduction processes, are nonetheless watching these fluid-bed methods closely. Main attraction is their relatively low capital cost compared to the traditional—and reliable—blast furnace.

In addition, fluid-bed units may be economical in small sizes, while blast furnaces have to be big to be economical.

And if steel scrap prices continue to climb —they've risen more than 40% in the past year—direct reduction may mean lower operating costs, too.

But don't look for direct reduction to supplant the blast furnace. Where coking coal is available, the blast furnace will long have an economic edge. But in our Southwest or in, say, India, direct reduction holds considerable promise. And some steel industry observers look for Jones & Laughlin to announce that it will soon use the HRI-Bethlehem process at a Texas location.

New process for pickle liquor disposal

A newly developed process for recovery of pickle liquor also has the attention of the steel industry (see above).

Developed in West Berlin by Zahn & Co., and now in sucessful commercial operation, it ends a waste problem by regenerating sulfuric acid and recovering the iron sulfate as the monohydrate—without the need for a crystallization plant. One or two U. S. firms are reported seeking rights to manufacture equipment for the process.

Essentially, Zahn runs hot, spent liquor to a spray dryer where a hot-air jet drives off water leaving a slurry of monohydrate crystals in concentrated sulfuric acid.

Centrifuging and filtering separate the crystals, adding dilute H_2SO_4 regenerates the acid to bath strength.

Barrett to make phthalonitrile

First large-scale commercial production of phthalonitrile, a pigment intermediate, will start next summer at the Edgewater, N. J., plant of Allied's Barrett Div. A new Barrett-developed process will be used.

Output from the multi-million-lb./yr. unit will enable phthalocyanine pigment producers to make step-saving changes in their production processes. Before 1942, imported phthalonitrile was the chief source of these high-quality pigments (though DuPont once had a captive production).

Short supply and high price of the imported product spurred a switch to a more difficult phthalocyanine synthesis starting with phthalic anhydride and urea. (For more on phthalocyanine pigments, see *Chem. Eng.*, May 1956, p. 138.) Barrett expects to price its product well below that of imported phthalonitrile (now about $1.05/lb.). It will sell development quantities for 75¢/lb., and looks for the price to drop even lower when the new plant comes on stream.

New centrifuge works at 100 psi, 300 F.

Process streams at up to 100 psi. and 300 F. can now be centrifuged on a continuous basis right on the line—without extra steps. Dorr-Oliver's new Merco pressure centrifuge is the first plant-size centrifuge to work at these pressures and temperatures.

In its first industrial use, the new machine is separating abrasive, clay-like, catalyst particles from solutions of polyethylene in hydrocarbon solvent. But on any high-pressure job at either low or high temperature, the pressure centrifuge can substantially reduce processing time and cost since the slurry doesn't have to be cooled or depressurized before centrifuging.

D-O's new unit works the same as other Merco centrifuges, performs the same basic separations, but it incorporates a number of features for high pressure operation. High internal pressures are held by a new housing closure that allows the shaft to deflect normally during rotation.

Industry bids for uranium plant contract

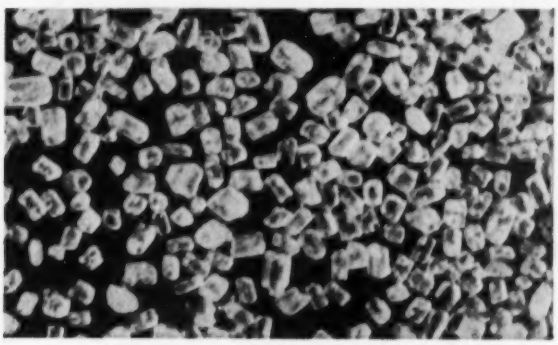
Seven industrial firms have responded to the Atomic Energy Commission request for help in producing refined uranium salts. (*Chementator*, Oct. 1956, p. 108). These salts now are produced in government-owned plants operated for the commission by civilian contractors.

AEC requested proposals from industry to supply uranium trioxide, uranium tetrafluoride, or uranium hexafluoride under five-year contracts. Contracts will be acceptable

(Continued on page 110)

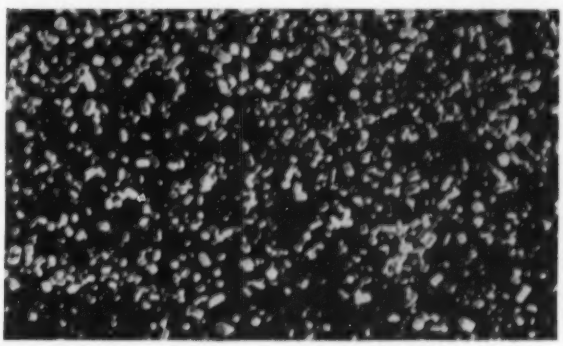
If you need...

...this uniform, large crystal oxalic acid for packaging radiator cleaners, wood bleaches . . .



Large crystals, magnified 3 times

...or this superior fine crystal oxalic acid for process use . . .



Fine crystals, magnified 3 times

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In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver

Basic Chemicals for American Industry

for rates of delivery up to 5,000 tons U_3O_8 equivalent per year. Deliveries will begin April 1, 1959.

The seven proposals received by the October 1 deadline came from: Union Carbide Nuclear, Koppers Co. and Kennecott Copper (joint proposal), Dow Chemical, Climax Molybdenum and Mallinckrodt (joint proposal), Allied's General Chemical Div., Vitro Corp. and Twentieth Century Materials Corp. (Twentieth Century is a newly formed company. Reportedly, it was set up by a group of Denver-based uranium operators.)

AEC expects to complete evaluation of the proposals by about Jan. 1, 1957. In evaluating, overall cost to the government for procuring the desired uranium salts will be a prime consideration, AEC says.

Among other things, proposals were supposed to include a cost breakdown of proposed price including information as to how plant amortization and interest charges have been computed and a complete itemized description of and cost estimate for construction of the proposed plant. Under the terms of the proposal, any contractor can purchase his initial uranium concentrates directly from AEC and sell back the refined sales if he desires. He is also free to make concentrates or to buy from other producers.

The program is part of the commission's efforts to increase private participation in the uranium industry. AEC officials regard the response by seven firms as "good."

Existing feed materials operations are operated for AEC by National Lead, Mallinckrodt and Union Carbide Nuclear. Another AEC plant, also to be operated by Mallinckrodt, is being constructed at Weldon Springs, Mo.

New synthesis route called feasible

Gas-phase chemical reactions in a luminous high-frequency electrical discharge are now "commercially feasible," according to Lord Manufacturing Co., Erie, Pa. Lord has been studying the method since 1944, says it opens a new route to hard-to-make chemicals —especially when synthesis requires high activation energy at relatively low reaction temperatures.

Essentially, the method involves activation, formation and subsequent removal of products in zones of controlled—and interrelated—pressure, temperature and residence time as the reactants pass through a radio frequency field of decreasing intensity.

Lord holds a patent (U. S. 2,684,329) on the technique, and a patent application now pending covers new and improved methods for using it. Most promising synthesis studied so far is the production of anhydrous hydrazine from ammonia. Yields are said to warrant further study on a pilot-plant scale.

Production of high-energy fuels for rockets and missiles, synthesis of intermediates for high-temperature-resistant polymers and other high-activation-energy materials also figure in Lord's plans for future research. Several companies are reported interested in the development and Lord may team up with one to handle future research, or it may license the method to one or more others.

Becco betters in-situ epoxidation

A new technique developed by Food Machinery & Chemical's Becco Chemical Div. may lower costs in present in-situ epoxidation process and make continuous-flow processing practical for the first time.

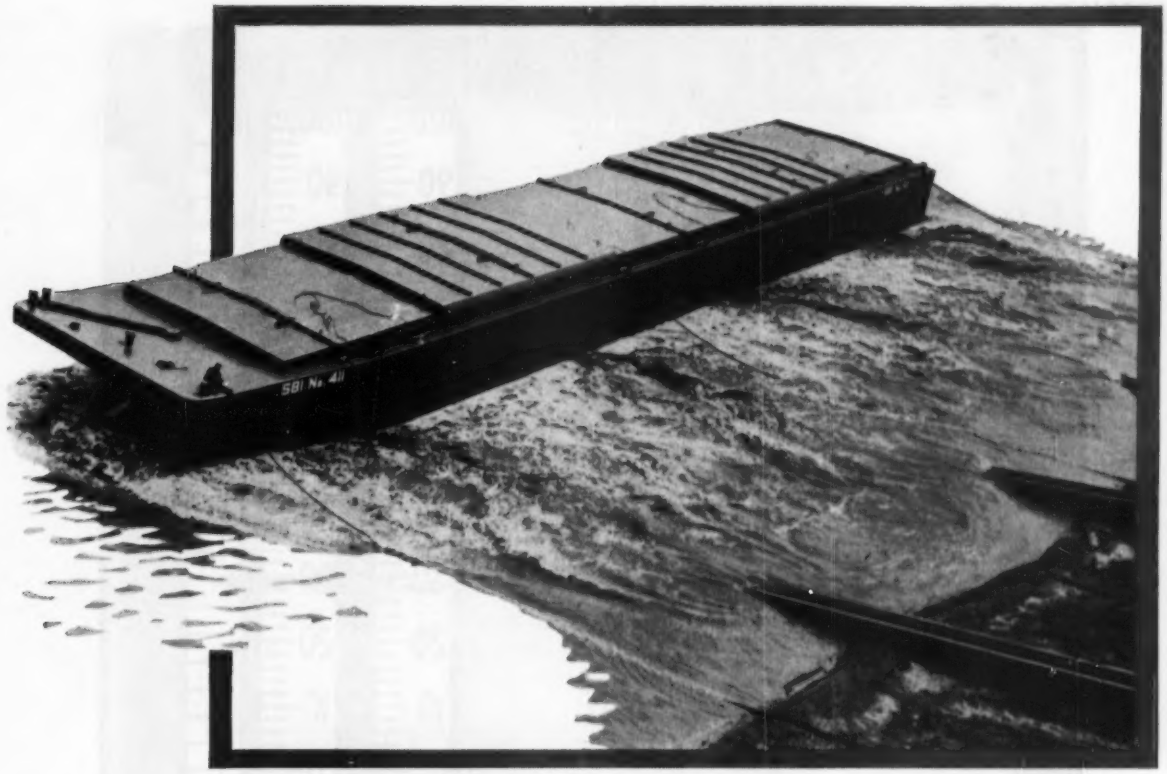
To make these in-situ processes competitive, the costly sulphonic acid cation exchange resins that catalyse the epoxidation reaction must be re-used. But these resins are attacked by the oxidizing medium used in the reaction and in re-use begin to fragilate, swell and degrade. This shortens resin life, adds to handling difficulties and lowers the reaction efficiency.

At the American Oil Chemists' Society meeting (Chicago, Sept. 24-26), Becco researchers revealed that this attack is induced and catalysed by metal contaminents in the resin and that it can be stopped by:

- Giving commercial resins an acid-wash to remove contaminents.
- Adding a sequestering agent—250-1,000 ppm. of polyamino carboxylic acid—to the epoxidizing medium to tie up any contaminents in the raw material, reagents or equipment.
- Using resins with a higher degree of cross-linking than usual.

Combining these techniques, Becco says, does the best job of increasing resin life and process efficiency.

For more of WHAT'S HAPPENING.....113



Joining the Olin Mathieson fleet

Here is one of the six new 1400-ton barges which will serve users of Mathieson chemicals. These 195-foot, all-steel barges are weather tight; the rolling hatch covers can be moved to expose 50% of the hold for easier loading and unloading.

The efficient use of water, rail and highway transportation helps customers get the full benefit of Olin Mathieson's multi-plant facilities. Whether you order by barge, car, truck, or drum, Olin Mathieson's experience with the logistics of the chemical process industries will enable you to buy to better advantage. Call your Olin Mathieson representative for complete information.

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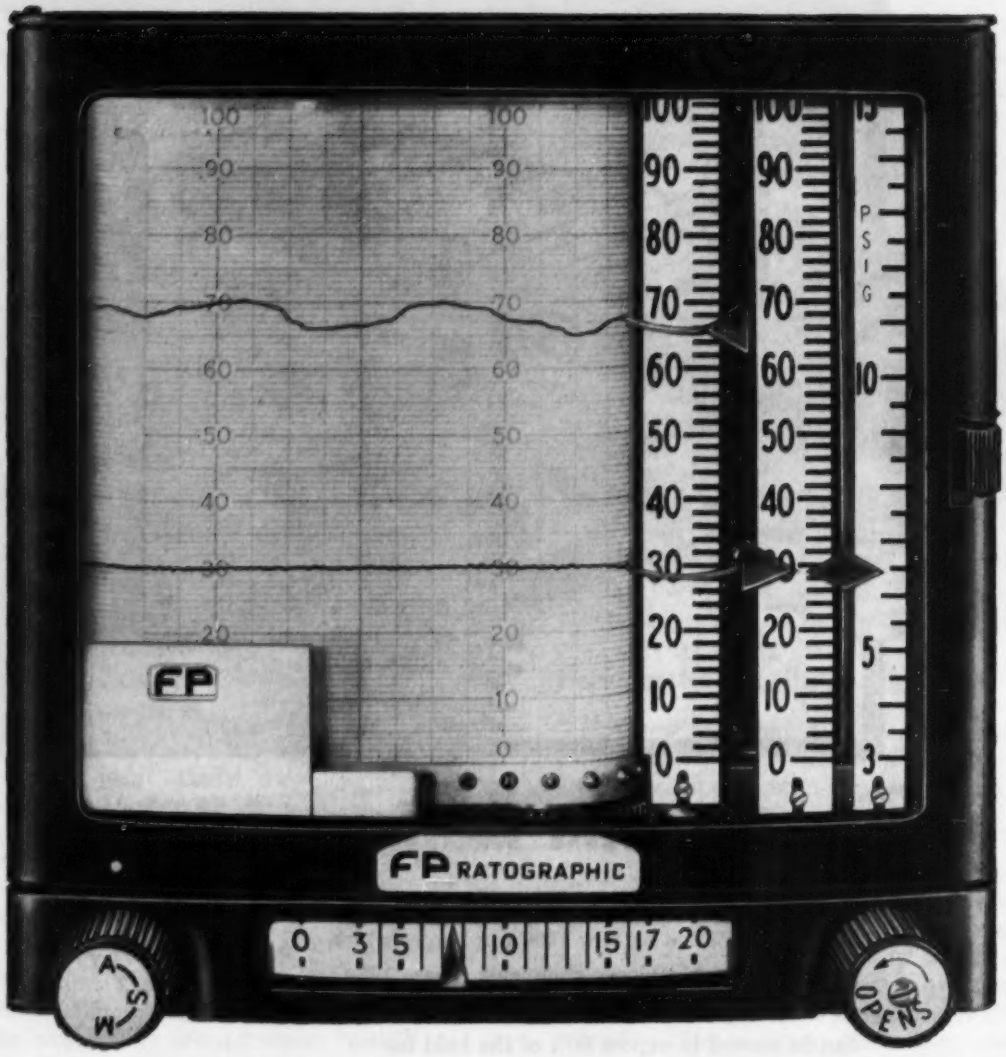

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COMPLETE PROCESS INSTRUMENTATION

What's Happening

NOVEMBER 1956 FEATURE NEWS

- **Urea-Adduct Process Gains Ground** 114

  Indiana Standard is latest to use this novel separation technique; two other refiners also dewax oils via extractive crystallization.

On-the-Run Blending Yields Solid Benefits 118

Automatic scales add ingredients continuously, conveyor-mixer blends them continuously to uniform product.

- **Fermentation Catalyzes Enzyme Business** 122

  Discovery that enzymes could be produced easily and cheaply by cultivation of micro-organisms is basis of today's commercial enzyme industry.

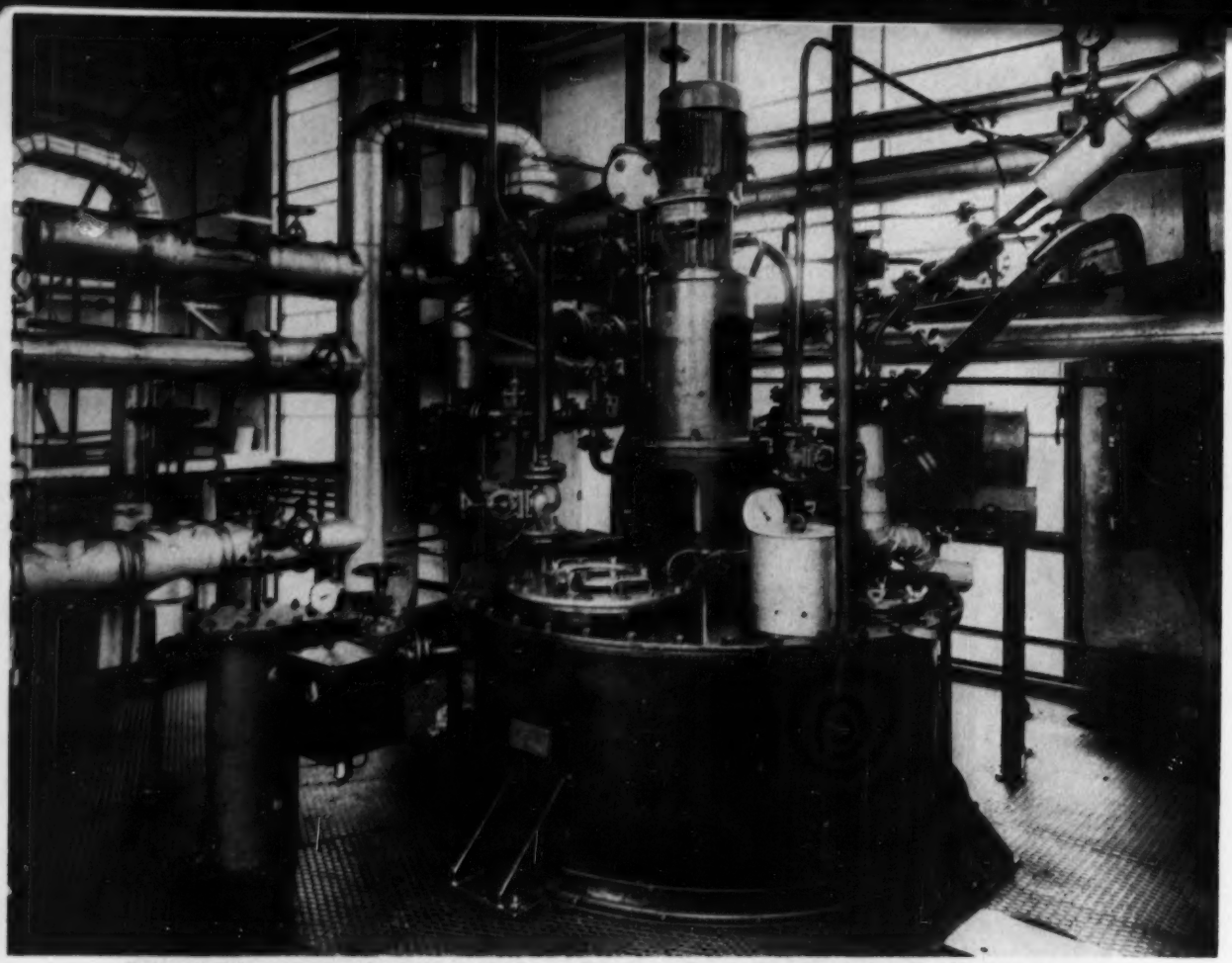
- **Isomerization: Inside Track in Octane Race** 128

  Pure Oil Co., recently announcing its new Isomerate process, swells the number of commercially available isomerizing proceses to five.

- **New Process Pulps Hardwoods** 134

  Chips substitute for the usual logs in making groundwood pulp, dealing strategic blows to today's twin shortages of newsprint and softwoods.

- **Convention Calendar** 120



FORMATION of urea adduct takes place in this reactor at Deutsche Erdoel's spindle-oil plant.

Urea-Adduct Process Gains Ground in

- Indiana Standard is latest to use this novel separation technique.
- Two other refiners also dewax oils via extractive crystallization.
- Many more have investigated this process; Shell cites improvements.

Extractive crystallization with urea — long hotly researched, lately much heralded but rarely used way to separate hydrocarbons—is taking a most impressive stride down its often-detoured road to full-scale commercialization.

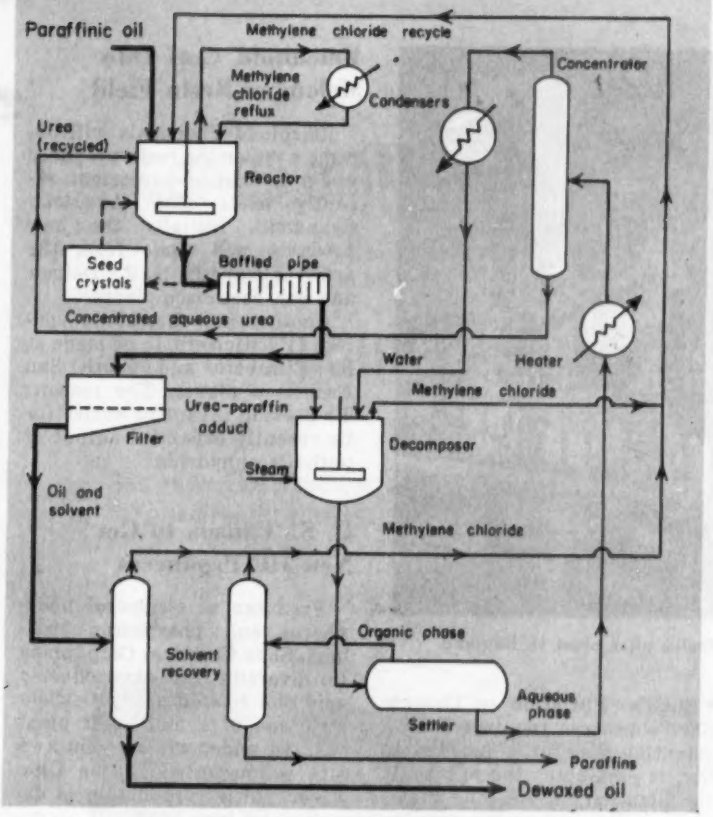
Standard Oil Co. (Ind.) is now bringing on stream at Whiting a $2-million plant that will produce more than 10 million gal./yr. of low-pour-point (—70 F.) lube oils by selectively locking wax-forming paraffins into filterable urea-complex crystals. Product is destined mainly for military Arctic use.

► **Indiana Makes Three** — The new plant marks the world's third and largest commercial application of this separation technique. All three users are doing the same type of separation—dewaxing.

Deutsche Erdoel A. G. (Heide, Germany), on stream since July 1955, produces 50 tons/day (approximately 5 million gal./yr.) of low-pour-point diesel and spindle oils via the urea route. And L. Sonneborn Sons, Petrolia, Pa., first (1950) to commercialize the process, goes after tiny traces of wax for a really low-cloud-point white oil.

► **No Refrigeration Needed**— While its more enthusiastic fans tout the process as a coming, all-round separation scheme to challenge distillation and extraction, it looks like extractive crystallization's commercial triumphs will continue to come in dewaxing jobs, for the time being, at least. Indiana's Vice President M. G. Paulus points out why:

- Urea crystallizes wax-forming paraffins at room temperature, saves the refrigeration costs levied against low-temperature processes.
- Urea cages all the wax-forming paraffins, even those that escape removal in conventional low-temperature dewax-



PROCESS operates at room temperature, avoiding use of refrigeration.

Lube-Oil Dewaxing

ing operations. Thus the new process provides a virtually wax-free oil with rock-bottom pour point, formerly made only from rare, wax-free crudes.

▶**Discriminating Urea** — Key phenomenon of the process, accidentally hit upon by German chemist Bengen in 1940, is urea's remarkable discrimination when it comes to hydrocarbons. It will form a complex (adduct) only with straight-chain hydrocarbons, never with branched, ring or cyclic ones. Using the normal hydrocarbon molecule as a helical-shaped mandrel, urea forms a honeycomb cage around it; together they drop out of hydrocarbon mixtures as long, needle-shaped crystals. Heat or water will break up the adduct.

As some 80 patents emphatically testify, this phenomenon suggests a wide variety of hydrocarbon separation jobs besides dewaxing. But to date none has proven commercial. Phillips (Bartlesville, Okla.) investigated the upgrading of jet fuels but set the project aside as uneconomical. Emery Industries (Cincinnati) reports a similar fate to its try at purifying fatty acids with urea.

▶**Stumbling Blocks**—Voluminous adduct (three times the volume of the feed) is tough to handle, requires big equipment; over-all process needs many stages—filtration, washing, distillation—to recover reagents, purify product streams.

For low-pour-point oils, savings in refrigeration or beating the need for wax-free crudes balances out these drawbacks. Otherwise the added expense would mean commercial suicide.

Shell Petroleum Co.'s Thornton Research Centre, Chester, England, reports a flowsheet that sidesteps some of these problems. Tried in a 3-gal./hr. pilot plant, it eliminates filtration and washing steps, keeps adduct in suspension to ease handling. Though not yet ready for commercialization, it points the way extractive crystallization may travel if it's to compete for other separation jobs besides dewaxing.

▶**Urea in Solution**—Though no process details have been released, Indiana Standard's new plant will probably follow in essence the successful flowsheets of Deutsche Erdoel and Sonneborn. These differ only in minor aspects.

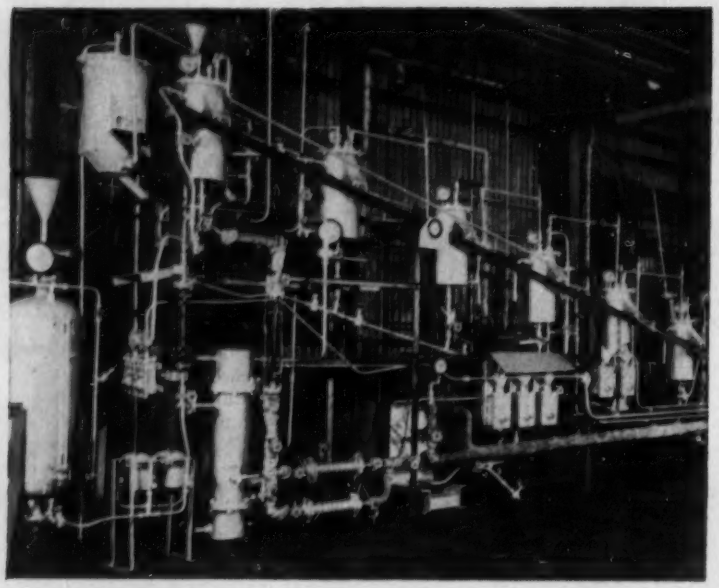
Deutsche Erdoel uses an aqueous solution of urea; Sonneborn uses a methanol solution. In the presence of water very little urea dissolves in the hydrocarbon phase, making its recovery much easier. On the other hand, presence of alcohol in the reaction mass speeds adduct building and keeps operating temperatures down to favor crystallization.

To control temperature the Germans introduce low-boiling-point methylene chloride. And to facilitate urea recovery Sonneborn introduces water at the decomposition step.

▶**How Germans Do It**—At Deutsche Erdoel's plant, equal volumes of oil, methylene chloride and aqueous urea (saturated at 70 C.) are charged into a vigorously agitated reaction tank. Crystallization begins almost immediately. Heat of the exothermic adduct-building reaction boils the methylene chloride. To keep the reaction humming at the desired temperature (35-45 C.) methylene chloride vapor is piped to a water-cooled condenser and refluxes to the reactor.

On its way from reaction tank to filter, the reaction mass gets added mixing, to insure maximum adduct formation, in a baffled pipe. Part of the stream recycles to inoculate the next reaction mass with crystal-promoting seeds.

Dewaxed oil runs through the filter to a solvent recovery plant. There water and methyl-



IMPROVED process may come out of Shell's pilot plant in England.

ene chloride are removed by settling and distillation, yielding the dewaxed oil product.

►**Urea Recovery**—Filter cake, composed chiefly of the paraffin-urea adduct, is washed to remove any dewaxed oil clinging to its surface, then transported to the decomposer—an agitated tank similar to the reaction vessel. Direct steam heats the adduct to 75 C., breaks it down to urea and normal paraffins. Methylene chloride that adhered to the adduct surface is driven off as vapor, condensed and recovered.

Urea solution and paraffins separate spontaneously in a settling tank. The paraffin layer, containing residual traces of methylene chloride, goes to a distillation tower for solvent recovery. Byproduct paraffins are being marketed to improve process economics.

Lower layer consists of dilute aqueous urea solution plus some methylene chloride. It is heated to 80 C. in a steam exchanger, concentrated to saturation at 70 C. Water removed in the concentration step is used in the decomposer to help break up the adduct. Concentrated urea solution, with some makeup, is reused in the reaction step.

►**Shell's Variation** — Though Shell's process requires longer retention time for adduct building, it eliminates the necessity for filtration and washing steps.

By making the adduct surface hydrophilic with surface-active agents, Shell keeps the adduct suspended wholly in the aqueous phase. Dewaxed oil separates neatly from this phase so that simple sedimentation gives easily handled adduct-water suspension, free of dewaxed oil.

Shell uses sodium alkyl sulfates as surface-active agents, isopropyl alcohol as solvent and aqueous urea solution saturated at 35 C. (50% concentration). These materials are mixed with the hydrocarbons while being pumped through six cascade-hooked agitated reaction tanks fitted with water-cooled coils.

Cold separation gives an aqueous phase containing the adduct in suspension and an organic phase of extracted hydrocarbon and alcohol. Adduct is decomposed with steam heat, with hot separation giving extracted paraffins and aqueous urea. Solvent recovery columns remove alcohol from the dewaxed product and from the paraffin byproduct.

Reichhold Gets Into Melamine Resin Field

Reichhold Chemicals will become a melamine resin producer under a license agreement recently made with American Cyanamid. Initially the new products will come from the firm's Elizabeth, N. J., Detroit and San Francisco plants.

Another new Reichhold venture: Plasticizers, to be made at its Elizabeth and South San Francisco plants. The reason: To provide a captive outlet for its recently expanded output of phthalic anhydride.

U. S., Canada to Get New HF Producers

Producer of elemental phosphorus and phosphorus products, Shea Chemical Corp. plans to diversify into hydrofluoric acid and related products. Construction of a multi-unit plant will get under way as soon as a site is chosen along the Ohio River. Initial production is expected by June 1957.

In Canada, Nichols Chemical Co., subsidiary of Allied Chemical & Dye, has started to construct at its Valleyfield, Que., works a liquid hydrofluoric acid plant—first such plant to be built in Canada. Both aqueous and high-purity anhydrous products will be made. The company is also considering the manufacture of derivatives.

Monsanto to Make Polyethylene in U. K.

Monsanto Chemicals Ltd. has started construction of a $23.8-million, 10,000-ton/yr. polyethylene plant at Fawley in Hampshire, England. The plant will be adjacent to Esso's refinery, from which it will draw feedstock.

The polyethylene plant is the first stage of a long expansion program planned by Monsanto. Upcoming are copolymers of acrylonitrile, butadiene and other monomers. And a major plant is to be constructed for the manufacture of acrylonitrile, not yet made in Britain.

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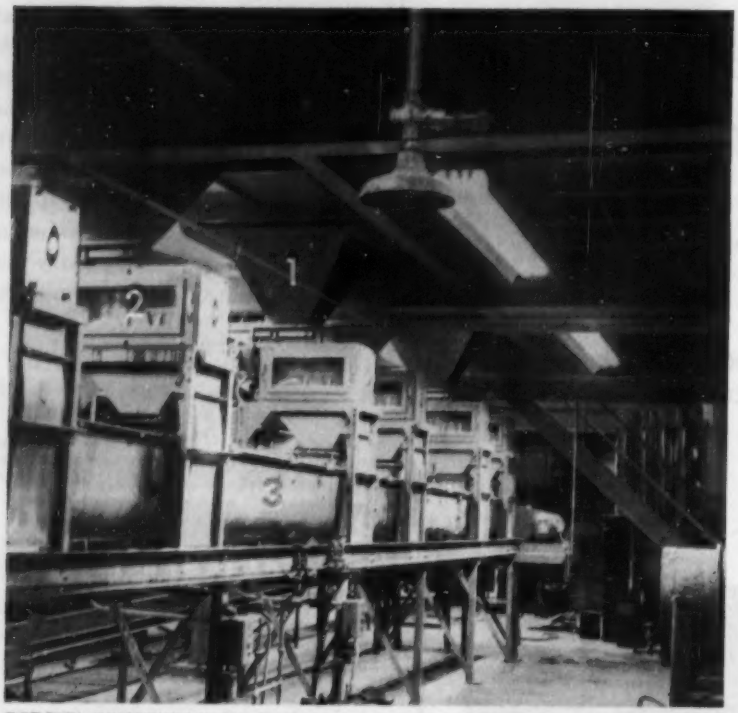
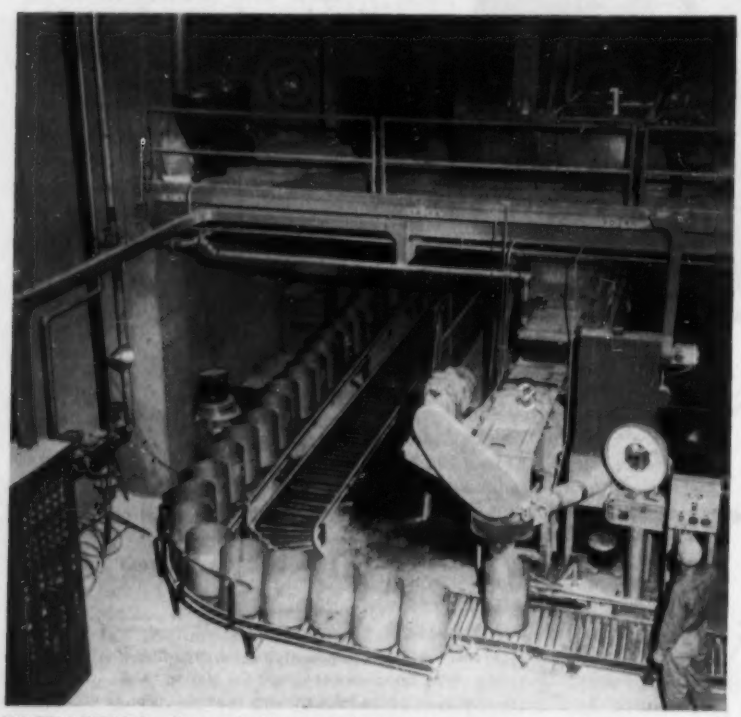
On-the-Run Blending Yields Solid Benefits



SCREW CONVEYOR, 54 ft. long, propels dry ingredients at 500 lb./min.



PACKAGING is electronically controlled via fast- and slow-fill valves.

1 Elevated hoppers feed as many as six different dry ingredients.

2 Automatic scales add ingredients continuously to conveyor-mixer.

3 Conveyor-mixer blends materials continuously to uniform product.

4 Automatic drumming marks end of swift passage through the line.

Dry compounding of chemical specialties, formerly a batch operation, is now an automatic, continuous-flow process at Turco Products' new $1-million Wilmington, Calif., plant.

Raw materials move from feed hoppers through automatic weighers into a continuous conveyor-mixer which delivers the compounded product directly to an automatic packaging station. Time of passage through the compounding line is as low as 2 min., compared with holdup times of 20-60 min. in the previously used batch mixers.

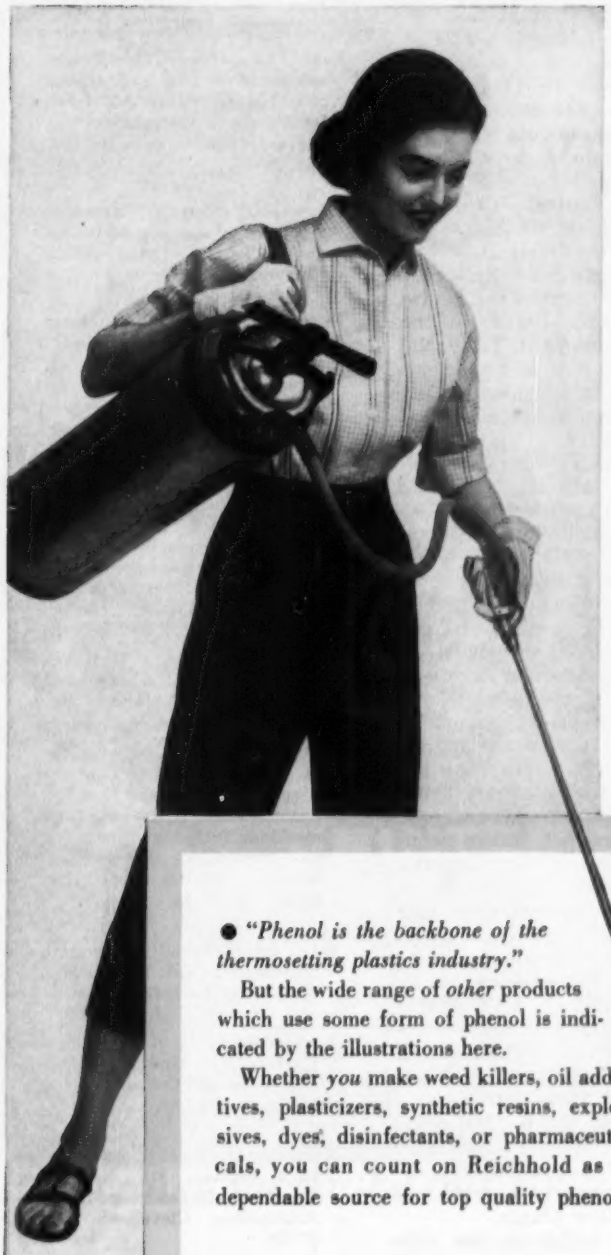
▶ **Fast, Accurate**—Turco's advanced approach to materials handling in its "dry line" has yielded these benefits to both compounder and customer:

- Unprecedented order-filling speed. Entire orders are frequently compounded and shipped in one day.
- More precise quality control. Formulating accuracy is 98-99.9%, depending on particle size and density.
- Low inventories. Necessary inventories are less than half of previous raw-material and finished-product inventory levels.
- Lower costs. More efficient materials handling puts the squeeze on direct-labor costs per unit of product.
- New product possibilities. Indications are that the potential of the new facilities is practically unlimited.

▶ **Careful Scheduling**—Because of watchful care, Turco is already reaping benefits from careful scheduling.

Because of the speed with

Weed killers?



Oil additives?

What's your need for top quality Phenol?

● *"Phenol is the backbone of the thermosetting plastics industry."*

But the wide range of *other* products which use some form of phenol is indicated by the illustrations here.

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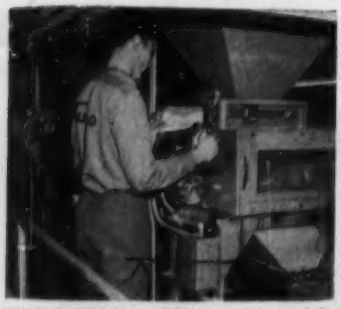
Maleic Anhydride • Sodium Sulfite • Pentaerythritol • Pentachlorophenol

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N. Y.



WEIGHING machines operate within tolerance limits of 0.5%.

which the new dry line can fill orders, raw-material, finished-product and container shipping schedules must be set up with more precision than ever. Much more than a hairline scheduling error could hold up a run, leaving the dry line with nothing to do but twiddle its mixers.

▶**Dry Line Equipment**—Turco's dry line consists essentially of a series of six automatic-weighing hoppers which gravity-feed various dry ingredients at preset rates into a 72-ft.-long continuous conveyor-mixer. The ingredients are automatically and continuously blended, sampled for quality control and dispensed into containers for shipment.

The conveyor-mixer is provided with dust-tight covers, sectionalized for easy access. Its 54-ft.-long conveyor section contains a 20-in.-dia. screw driven at 80 rpm.

The 18-ft.-long mixer is powered by a 10-hp. motor with a variable-speed drive ranging from 60 to 180 rpm. Turco describes it as a "combination of paddle and ribbon mixer," declining to disclose details.

The hoppers are spaced at 9-ft. intervals.

▶**Dry Line Operation** — The main dry ingredients of a compounding run are unloaded by conveyor from railroad cars or trucks directly into two 85-ton bins over the dry line. These materials flow by gravity into the automatic feeder hoppers.

Other dry materials are charged to the hoppers or "batch bins" from sacks or drums. Liquid ingredients, sometimes added to dry-powder mixes, are pumped from drums directly into the mixer.

Solids move through the conveyor to the mixer at a rate of up to 500 lb./min. Linear rate of travel is 8 to 14 ft./min., depending on the density of the material. Ingredients which infiltrate the mass more slowly are added upstream.

▶**Dry Line Control**—The automatic weighing machines are set before each run in lb./ft. of travel of the conveyor screw. Electronic controls insure 0.5% tolerance limits on the weight of ingredients fed to the conveyor. Out-of-tolerance operation automatically shuts down the entire line until the trouble is found.

Electronically operated filling scales key an automatic container-filling procedure. Two hydraulic cylinders control fast- and slow-fill valves. When 95% of the desired weight of the finished product has been poured into the waiting drum or sack, the fast-fill valve cuts off and the slow-fill valve carefully meters out of the last 5%.

By means of an ingenious continuous takeoff mechanism located about 4 ft. from the discharge end of the mixer, Turco chemists get a sample of the finished product taken continuously during the entire run of that product. Rate of sampling is set by the operator. One product might require a 10-lb. sample every 15 min., whereas another might require 10 lb. every minute. G. A. T. Washburn, who supervised engineering and startup of the plant, is proud of this device.

▶**Three for One**—Turco's new plant which, besides the novel dry line, includes a comparable "wet line," centralizes the operations formerly carried out in three other plants.

The old buildings are ticketed for expanding research and development and other facilities. The employees displaced by the new automatic compounding lines have been quickly absorbed by Turco's new Chem-Mill division (metal treating and pickling) and its growing equipment division.

According to President S. G. Thornbury, Turco expects the new Wilmington specialties plant to soon double its present 4-million-lb/mo. output.

Convention Calendar

Energy Resources Conference, sponsored by Denver Chamber of Commerce, major addresses by leaders in fuel and nuclear energy industries, Denver, Oct. 29-30.

Commercial Chemical Development Assn., meeting on detergents, Terrace Plaza Hotel, Cincinnati, Nov. 1.

Fifth Annual Instrumentation Conference, Louisiana Polytechnic Institute, Ruston, La., Nov. 1-2.

American Council of Independent Laboratories, annual meeting, Savoy Plaza, New York, Nov. 2.

American Institute of Chemical Engineers, Chicago section all-day meeting, Conrad Hilton Hotel, Chicago, Nov. 7.

Chemical Market Research Assn., "New Methods and Techniques in Market Research," Harvard Business School, Boston, Nov. 13-14.

National Assn. of Corrosion Engineers, north central regional meeting, includes discussions on corrosion in the chemical industry, Statler Hotel, Detroit, Nov. 15-16.

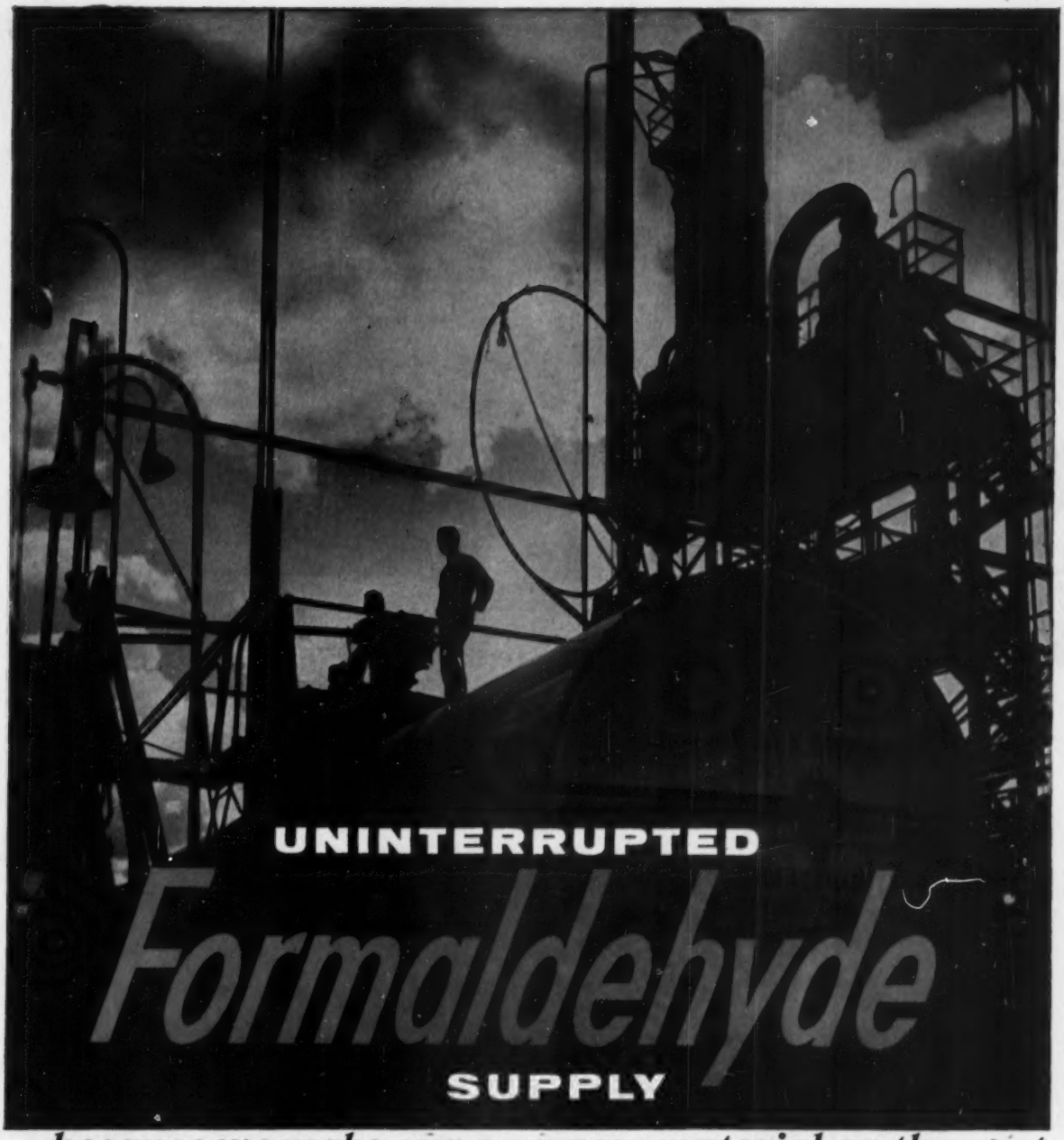
Third International Automation Exposition, Trade Show Bldg., New York, Nov. 26-30.

American Society of Mechanical Engineers, 22nd National Power Show, Coliseum, New York, Nov. 26-30.

American Chemical Society, Chicago section, 9th National Chemical Exposition, Public Auditorium, Cleveland, Nov. 27-30.

Seventh Film, Sheeting and Coated Fabrics Div. Conference, Society of the Plastics Industry, Inc., Commodore Hotel, New York, N. Y., Dec. 4-5.

American Institute of Chemical Engineers, annual meeting, includes symposia on low-temperature processing, advancing automatic control of chemical processing plants, Statler Hotel, Boston, Dec. 9-12.



...because we make our own raw material on the spot

When you buy formaldehyde from Allied Chemical, you can be sure of steady supply — and purity. Because Allied produces the basic raw material, methanol, right at the same plant where the formaldehyde is made.

You get prompt delivery in tank trucks and 8,000 and 10,000-gallon tank cars — because of Allied's central location at South Point, Ohio, and its customer-convenient bulk terminal locations. Phone or write for specific details about delivery, prices and technical service.

Dept. F. 1-5-2

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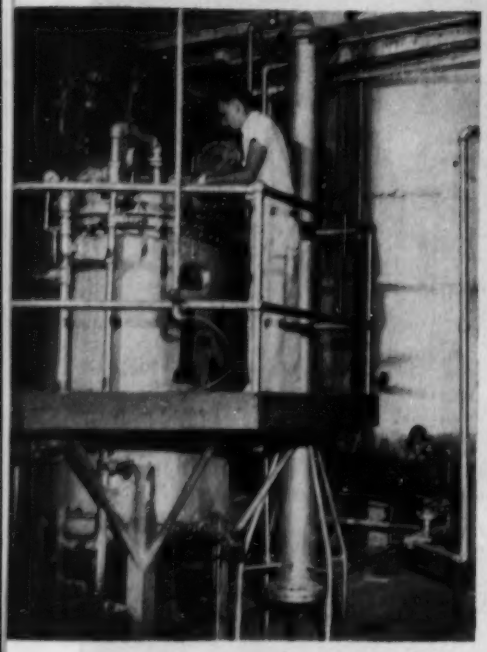
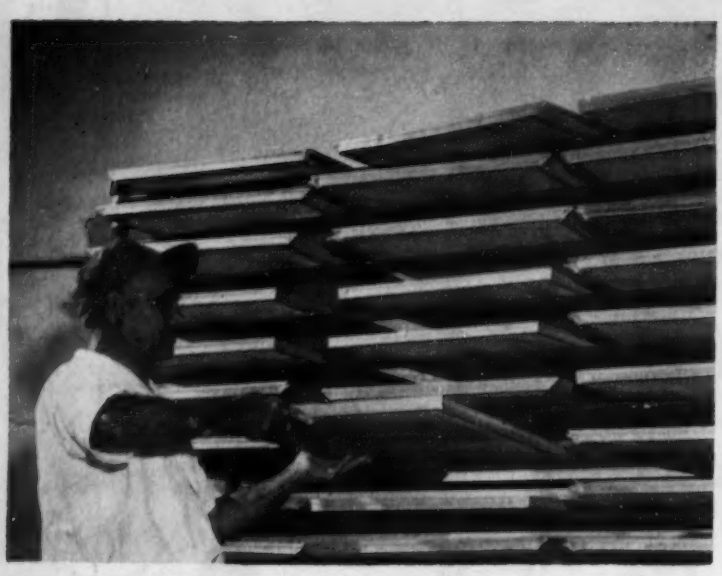




In deep fermentor (submerged) or in shallow pans . . .

Fermentation Catalyzes Enzyme Business

Discovery that enzymes could be produced easily and cheaply by cultivation of micro-organisms is basis of today's commercial enzyme industry.

Technology of industrial enzyme manufacture, an old but relatively unexploited industry, is coming in for some livening up soon. The same can be said for enzyme products.

It's high time, too. For although commercial enzyme preparations have been employed by industry for more than 50 years, total annual sales today probably do not exceed $20 million. Within the next decade, however, they could be over $100 million.

Miles Laboratories' acquisition of Takamine Laboratory last spring was recognition of the growth potential of industrial enzymes. Coalition of Miles' resources and fermentation know-how plus Takamine's long experience as a pioneer in microbial enzyme production should produce significant results.

Then there's the news that Dole Hawaiian Pinapple Co. plans to recover bromelin, a proteolytic (protein-splitting) enzyme, from pineapple wastes. Dole's move marks a further awareness of enzyme market potential and the possibility of enzyme recovery as a byproduct of food processing.

▶ **What Enzymes Can Do**—Commercial enzyme preparations make chuck steak as tender as porterhouse, recover silver from photo film, help the dry-cleaner take the food stains out of your best suit, make that cold glass of beer in hand sparkle the way it does on the television screen, may even help you get rid of a black eye.

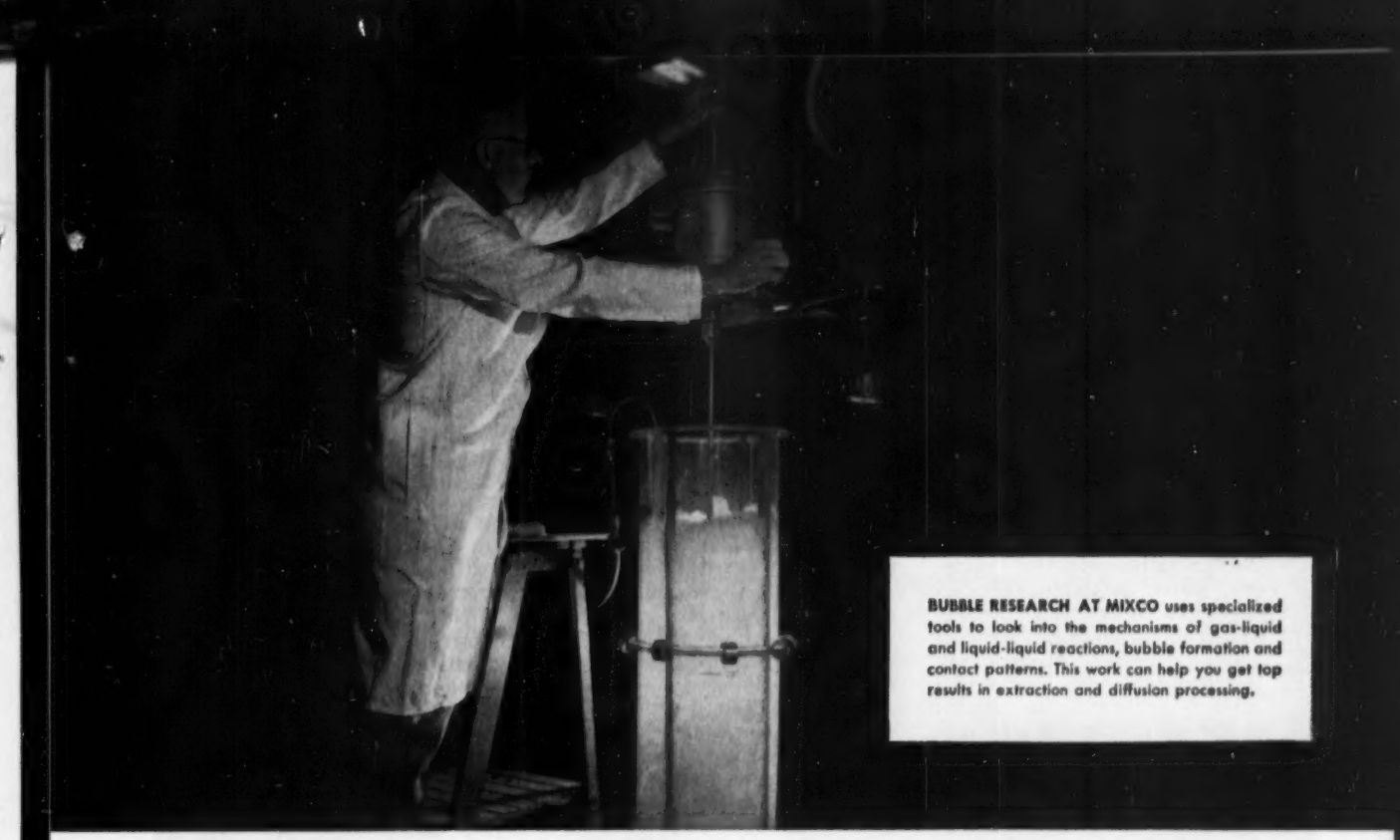
Your wife can thank industrial enzymes for the packaged (egg-containing) cake mixes on the supermarket shelves, for rendering peroxide bleaches harmless, for making it possible to do something with fruit juice besides make jelly.

Enzymes help your baby digest starch and proteins when his body chemicals fail him, help make drugs to ease grandma's arthritis pains.

Add leather softening, paper sizing and textile desizing and surgical dressings to enzyme accomplishments and you've quite a record.

▶ **Enzymes in the Food Industry**—There's an enormous market for enzymes in food processing, especially now that it's been revealed that enzymatic action can restore and/or enhance the flavor of dehydrated, canned and frozen foods.

Perhaps the brightest promise lies in recovery of myriad chemicals from food-processing wastes via enzymatic action. One spokesman for a big food-processing firm says that the chemical potential of these



BUBBLE RESEARCH AT MIXCO uses specialized tools to look into the mechanisms of gas-liquid and liquid-liquid reactions, bubble formation and contact patterns. This work can help you get top results in extraction and diffusion processing.

What's the effect of **mixing** *in gas-liquid and liquid-liquid systems?*

Do you think good mixing might make a big difference in the way a gas-liquid or liquid-liquid reaction behaves?

We can help you find out, for sure.

You probably want to know whether there's a simple way to discover the just-right balance of fluid flow and turbulence for greatest possible contacting efficiency. (There is.)

You're almost certainly interested in the relative efficiencies of small and large mixing impellers, under varying conditions of impeller speed and position. (We can pin them down for you, quickly.)

How to save research time

If your work involves gas-liquid contacting, you can save time by letting us figure out for you the most effective sparge ring diameter, and placement of holes, for a given horsepower level and gas flow combination.

On *any* fluid mixing operation, consider the time you'll save by making your pilot runs with calibrated mixing impellers that let you calculate power directly from simple speed measurements. (You can get these impellers from us; or have us do the calculating for you.)

And when you're ready to put the unit on stream, get the advantage of mixer selection from an almost unlimited range of power and speed combinations—with results accurately predicted and *unconditionally guaranteed.*

Doesn't this sound like the *practical* way to put fluid mixing to work for more profitable processing? Thousands of process engineers have found it so. For quick, competent help, phone your LIGHTNIN Mixer representative (listed in Chemical Engineering Catalog). Or write us direct.

"Lightnin' Mixers"

MIXCO fluid mixing specialists

HIGH-RATE GAS-LIQUID contacting operation is performed economically by twelve 200-HP turbine-type LIGHTNIN Mixers with multiple impellers.

FOR LATEST MIXING INFORMATION and full description of LIGHTNIN Mixers, send for these helpful bulletins:

- ☐ B-102 Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP
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- ☐ B-104 Side entering: 1 to 25 HP
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- ☐ B-109 Condensed catalog showing all types
- ☐ B-111 Quick-change rotary mechanical seals for pressure and vacuum mixing
- ☐ B-107 Data sheet for figuring mixer requirements

Check, clip, and mail with your name, title, company address to:

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In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.

wastes may even dwarf that of lignin from the wood pulp industry—and that the best route, maybe the only route, to these chemicals is through enzymatic processing.

▶**How Enzymes Work**—Most enzyme preparations on the market today are mixtures of enzymes belonging to the hydrolytic class. They help break chemical bonds to get smaller molecules.

Coming to the fore now are the oxidative-reductive varieties, which catalyze very specific reactions. Since their chemical action must be pinpointed, "foreign" enzymes may interfere with efficiency of the catalysis. Thus initial microbiological production and subsequent recovery will demand greater processing finesse.

▶**How Enzymes Are Made**—Takamine Laboratory manufactures industrial enzymes at its Clifton, N. J., plant by extraction from animal and plant tissue, and by fermentation. If the starting material is some specialized tissue, it may be processed directly—minced, extracted, the extract filtered and the enzyme precipitated, dried, ground, blended and packaged.

If fermentation is to be the route, the organism must first be developed and the medium in which it is to produce the enzymes prepared. Equipment for preparing media is usually a glass-lined or stainless steel agitated pressure vessel with jacket or coils.

First the medium (cornsteep liquor, wheat bran, etc.) is cooked with dilute HCl and sterilized for 30-60 min. by direct injection of 15-psi. steam. The batch is cooled to about 30 C. by injection of sterile air or external cooling water, with positive pressure maintained in sterilizer to keep contaminating organisms out. Then inoculum (microbial spores) is fed to the sterilized mash by means of proportioning feeders.

▶**Surface Culture**—After mixing, the inoculated media, or mash, is conveyed to incubation chambers. There it is spread in thin layers on trays with woven screen bottoms. Temperature of the incubating culture is controlled by continuous recirculation of warm, humidified, sterile air.

To obtain an unusually large surface for micro-organism growth, special culture vessels have been used. One of these is a vertical tank (it may be up to 8 ft. high, 6 ft. dia.) with removable head. A heavy shaft goes through the center, passing through a stuffing box in the tank head. Fastened to this central shaft is a vertical stack of shallow circular trays. Each tray has an overflow, so operator can fill each with mash from the sterilizer, starting with the top tray, until the bottom spills over.

▶**Submerged Culture**—If the ultimate destination is submerged fermentation (more and more the method of choice) the sterilized mash is fed to a cooler and flashed to atmospheric pressure before sending to a production fermentor.

Seed tanks and production fermentors for submerged culture are equipped with air spargers and agitators. (Takamine uses 3,000-gal. vessels now, may go to 5,000 gal. soon.) Air is sterilized by filtration through carbon filters before use. When maximum enzyme activity is attained in the culture, aeration stops and bacteria or mold is filtered out.

All culture vessels, whether for submerged or surface growth, together with connecting lines to sterilizer and air filter, are sterilized with steam before charging. Tank fermentor may be charged with inoculated medium by slight overpressure with sterile air in sterilizer.

▶**Finishing Steps**—Should the enzyme be marketable in liquid form, a NaCl and suitable antiseptics (e.g., pine oil, thymol) are added to the filtered broth to prevent putrefaction.

To get a dry product the filtrate is concentrated (usually at less than 50 C. and at neutral pH) under vacuum to a heavy syrup. Addition of a water-miscible organic solvent (e.g., acetone or alcohol) will precipitate the enzyme material nearly quantitatively; better than 90% recovery is the rule. Or a saturated solution of ammonium sulfate will suffice. The precipitate (industrial enzymes are not purified to the extent that they will crystallize) is centrifuged and air- or vacuum-dried to 5-10% moistures at temperatures usually under 55 C.

Precipitated and dried enzyme material is usually used without further purification. There may have been some inert protein, inorganic salts and other enzymes present in original filtrate which were preferentially precipitated and removed before desired material was separated. Or if they remain they may not necessarily interfere with enzyme utility.

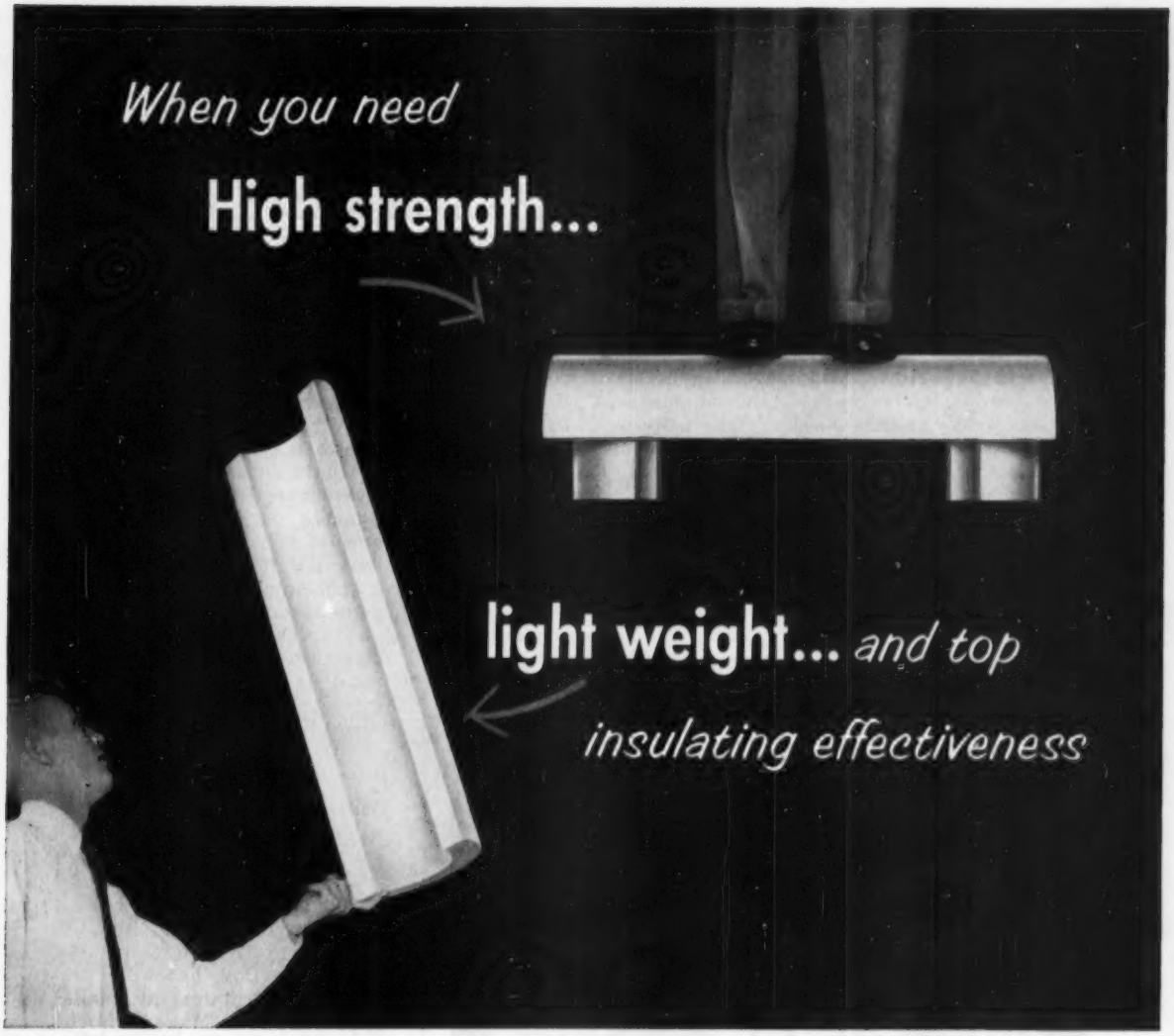
▶**Dilution, Standardization**—These enzyme concentrates may, however, be too potent for industrial purposes and are diluted to a standard strength with inert substances like sugar, salt and diatomaceous earth. These dilution requirements and the variability in concentration of precipitated enzymes make for a great deal of blending, grinding and sifting before packaging.

There are many ways to further purify commercial enzymes, and they will have to be resorted to more and more in the future: Fractional precipitation, dialysis and selective adsorption on alumina, silica gel and ion-exchange resins (enzymes, being protein, behave like charged ions depending on pH). For dialysis, aqueous solutions of enzymes are passed through semipermeable membranes like cellophane and parchment. Enzymes remain behind, ionized salts pass through.

Enzyme separations have even been achieved by selective foaming or flotation processes; the more surface-active enzymes are more susceptible to flotation.

Coke-Oven Operators Swing to DAP

Ford Motor Co. has changed its method for ammonia removal from coke-oven gas so that, instead of ammonium sulfate, 80,000 lb./day of diammonium phosphate is produced at the Rouge plant in Dearborn,



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J-M THERMOBESTOS®—the heat insulation designed for outdoor process industries

For insulating outdoor process equipment, only Johns-Manville Thermobestos adds so many physical advantages to unsurpassed insulating efficiency.

To its low thermal conductivity, there's the welcome addition of strength and rigidity. Similar in chemistry to Portland cement, Thermobestos resists crushing . . . easily withstands unusual operating abuse without appreciable damage. As for weight, you can lift even the largest piece of the material with one hand. And, of course, Thermobestos is not damaged by prolonged wetting or exposure to water vapor.

This unique combination of properties means excellent temperature control (to 1200F) and minimum maintenance cost. It is ideal for oil refineries, chemical processing plants and other plants with outdoor vessels and hot piping.

Made from hydrous calcium silicate, Thermobestos is molded to size for proper fit. Its high strength makes it particularly adaptable for time-saving shop prefabrication of fittings and bends. Thermobestos is easy to apply, and is furnished in large sections which reduce the number of joints. In half-section form it comes in sizes up to 24″ pipe diameter by 3″ thickness. Also available in 6″ x 36″ and 12″ x 36″ blocks in a full range of thicknesses. For information write to Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ont. Ask for brochure IN-169A.

JM PRODUCTS

Johns-Manville *first-in* **INSULATION**

MATERIALS · ENGINEERING · APPLICATION

Mich. Since the conversion—accomplished with technical assistance from Monsanto—Ford uses electric-furnace phosphoric acid in place of sulfuric acid for "washing" the COG.

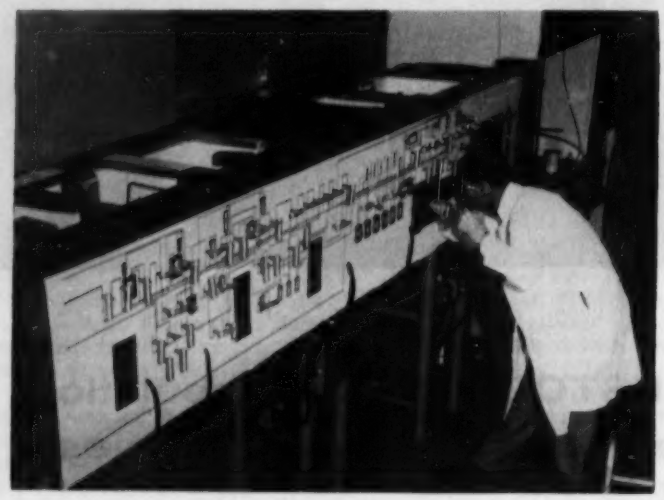
And Monsanto, at the Pueblo plant of Colorado Fuel & Iron, is building a phosphoric acid unit which will supply acid for CF&I's production of diammonium phosphate. First of its kind and size, the new phosphoric acid unit has been engineered specifically to meet needs of CF&I's coal chemicals operation. Elemental phosphorus will be shipped from Monsanto's electric furnace plant at Soda Springs, Idaho.

CF&I, a diammonium phosphate producer since January 1955, has been marketing most of its DAP in the Midwest, is now reported to be spreading westward. Prodded by a growing demand for phosphate fertilizers in western states, Shell Chemical Corp., too, is making DAP at its Pittsburg, Calif., plant. Plant started producing DAP at a rate of 5,000 tons/yr. early this summer (*Chem. Eng.*, July 1956, p. 114), while maintaining existing ammonium sulfate production.

Another western coke-oven-gas producer, U. S. Steel at its Geneva works in Utah, is likely to plunge more heavily into nitrogen base chemicals, though not specifically DAP. Interviewed recently at Salt Lake City, executive assistant Ben S. Chapple pointed out that the plant is in a position to triple its production of these chemicals at its new anhydrous ammonia and ammonium nitrate plant at Geneva.

Present 200-ton/day plant utilizes about a third of the coke-oven gases. Demand increases would lead to installation of additional units at the $18-million facilities due to go on stream in January. Original plant design and layout was projected to allow for this potential growth.

The company expects to sell a larger amount of basic grades of nitric acid from the plant. Contracts have been signed with a uranium company and explosives maker for sale of this acid. Chapple did not disclose amount of nitric, except to say that half the total 200-ton/day output would go to nitric and ammonium nitrate, the rest to anhydrous ammonia. Present commitments and orders now pending virtually allocate the total initial production of the ammonia facility.



Hanford Plant Prototype Tests U-Pu Separations

Small-size plant developed by General Electric engineers at the Hanford atomic plant duplicates most facilities of the actual plant for separating plutonium from uranium. It tests chemical methods of separating plutonium from uranium that has been irradiated inside an atomic reactor.

The prototype also cleanses uranium of highly radioactive fission products formed when uranium atoms split in half to produce neutrons that sustain the plutonium-producing chain reaction.

Despite small size, the plant weighs more than 30,000 lb. because of heavy lead brick walls which absorb radiation from "hot" solutions inside.

More Catalyst for More Butadiene Making

Dow Chemical Co. has started construction of a $2-million plant at Ludington, Mich., to produce catalyst used to make butadiene. Dow has been producing the catalyst in smaller quantities at its Midland, Mich., facilities since 1945. But current plans to expand butadiene capacity, touched off when the government handed synthetic rubber production over to private industry earlier this year, provide Dow with ample market space for its new output.

Second Move Southward For Wyandotte

Confirming a recent CE prediction (Sept. 1956, p. 114), Wyandotte Chemicals will build an electrolytic chlorine-caustic soda plant in Louisiana, second major phase of its expansion into the South. The $20-million plant, to produce 300 tons/day of chlorine and 330 tons/day of caustic, will be adjacent to the ethylene oxide plant which the company started building near Baton Rouge last summer.

HORTONSPHERE...with an Overcoat...

designed for 75 lbs. per sq. in. working pressure
stores anhydrous ammonia

This 15,000-bbl. Hortonsphere®, insulated and refrigerated to help reduce pressure of stored anhydrous ammonia, is located at the Curry Chemical Company, Funk, Nebraska. It has been designed to withstand internal pressure and will not allow contents to escape as long as the setting of the pressure relief valves are not exceeded. Hortonspheres, for the storage of such liquids as anhydrous ammonia, butadiene, and other volatile liquids, are available in sizes to 30,000 bbls. Write our nearest office for complete information or quotations.

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Isomerization: Inside Track in Octane Race

PURE OIL	**Isomerate: "Produces top quality premium fuel."**
UOP	**Penex: "Improves over-all yield-octane picture."**
ATLANTIC	**Pentafining: "May be of real interest to some."**
STANDARD (Ind.)	**Isomate: "Now being improved and adapted."**
SHELL	**Liquid-phase isomerization: "Logical step."**

It's no great achievement today for a runner in the octane race to pass the 100-octane marker. The secret is to get there without bursting your economic lungs—and those last few octane numbers are mighty taxing.

Pacesetters, not all vying for the fastest time themselves, are angling for an increasingly attractive inside lane—isomerization, or the upgrading of low-octane normal pentane and hexane to their higher-octane, branched-chain isomers.

▶**Newest Entry**—Pure Oil Co., recently announcing its new Isomerate process, swells the number of commercially available isomerizing processes to five (see above table). Arthur G. McKee & Co., contractor for Pure's process, reports country-wide interest since Pure's July announcement.

Other pacemakers: Universal Oil Products, with Penex; Atlantic Refining Co., Pentafining; Standard Oil Co. (Indiana), Isomate; Shell Development Co., liquid-phase isomerization. UOP and Atlantic are also recent entries, whereas Indiana and Shell are dusting off processes developed to meet World War II needs.

Although there are reportedly no pentane or hexane isomerization processes in commercial use today, current interest seems to indicate a warmup for tomorrow's home-stretch sprint.

▶**Quiet Excitement** — Oilmen understandably shy away from the term, "octane race." Everyone backs his favorite contestant, but cheering is at a subdued level.

Owners of the newest isomerizing processes are less reticent, but by no means voluble. Those who may bring forth such processes in the future say very little. For example:

• Esso Standard says only that it is now working on pentane isomerization in the research and development stage.

• Phillips Petroleum Co., keeping mum on the whole thing, was recently granted a patent on a new isomerizing catalyst (for C_5, C_6 and C_7) different from any now in use. The company is known to have facilities at Phillips, Texas, for isomerizing a mixture of normal hexane and methyl cyclopentane.

▶**Why Isomerize?** — Why the sudden scurry in the isomerizing direction?

For one thing, automobile engines in the near future will tolerate much less catalytically cracked stock than is in today's fuels. The unfavorable gap between laboratory-determined octane number (research octane) and octane performance realized on the road (road octane) is growing as octane numbers rise. Detroit is mulling the problem of designing engines for maximum utilization of high octanes, and there is a trend to boron additives in fuels to alleviate severe engine demands.

On the other hand, catalytic reforming of low-octane naphthas, now a busy refining route, has nearly reached its upper severity limits. Super-octanes by this method would result in high volume losses. Also, high-severity reforming gives a lot of aromatic compounds, some of which have been blamed for combustion problems.

Finally, alkylation—combining propylene, butenes or pentenes with isobutane to produce high-octane branched chain paraffins—is a fairly high-priced toll-bridge, despite its current popularity.

▶**Two And Two Are Five**—Isomerizers are after these laurels:

• Isomerization yields are high; products are cleaner burning than catalytic reformates and cracked fractions.

• Octane numbers of isomerization products appreciate on blending; a 96-octane product plus a 95-octane reformate blend to give a 100-octane gasoline. In contrast to present fuels, road octanes of such blends are often higher than their research octanes.

• The C_5, C_6 and C_7 fractions which resist catalytic reforming are, in effect, an open valve on the octane level of refinery gasoline pools. There is a 20-octane difference (with 3 cc. tetraethyl lead/gal.) between normal pentane and isopentane, and 30 to 40 octanes between normal hexane and its isomers.

▶**High Octanes, Yields, Hopes**—Pure, Atlantic and UOP all affirm that isomerization is the next giant step to higher octanes. Indiana Standard is improving and adapting its process to produce high-octane motor fuel, and Shell, too, is working on improvements.

Any of these processes can be used either on a light, straight-run naphtha (one that hasn't been cracked or reformed) or in conjunction with catalytic reforming. This means that reforming severity can be lowered

PROCESS ENGINEERING REPORT

PROJECT NO. 56-49

FILE REF. 011.92

SUBJECT: Test Program at Sharples Pilot Plant

MATERIAL: Formulation K-92

OBJECTIVE: Classification of above to:
100% < 10 microns
90% < 2 microns
Sharp cutpoint required
Oversize to be reprocessed

RESULTS: Production quantities were run in a PN-14 Super-D-Canter at controlled bowl speeds from 500 rpm to 4000 rpm. As predicted, we needed 4000 rpm (3180 x g) to do the job. Actually bettered our specs (91% < 2μ). Cutpoint consistently sharp; anticipated capacity maintained in spite of fluctuation in input concentration.

RECOMMENDATION:

a. Immediate purchase recommended. These tests are conclusive.

b. Super-D-Canter can also be used at lower speeds on Formulation B-8 for roughing out agglomerates.

The Sharples Super-D-Canter spans the wide range of particles from very large to those of only a few microns in size. Write for Bulletin 1254.

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and still exceed previous octane ratings with the final blend.

Atlantic, Pentafining natural gasoline, reports octanes (leaded with 3 cc. TEL) of 99.5 and 100, with product yields of 95 and 93.5 vol. %, respectively; is now at work on hexane isomerization, will go eventually to C_7.

UOP has upped leaded octanes to 97 and 98 with 99 vol. % yields of C_5 products, 97 vol. % of C_6 products.

Standard of Indiana, operating with recycle, attains 82 vol. % yields of hexane Isomate of 106 leaded research octane, 107 leaded road octane.

▶**Thumbnail Flowsheet**—Present isomerizing techniques all follow the same broad outline: Incoming feed is split into suitable fractions and isomerized over a platinum or anhydrous aluminum chloride catalyst.

In each case, to suppress cracking and disproportionation, enough hydrogen is added to the system to maintain operating pressures of 200-800 psi. With $AlCl_3$, hydrogen chloride is used as a promoter.

Operating temperatures range from 180 F. for Shell and 250 F. for Indiana (both $AlCl_3$) to 800-900 F. for Atlantic (platinum).

Atlantic and Shell isomerize C_5, while Indiana, UOP and Pure have adapted their processes to isomerize blends of C_5 and C_6.

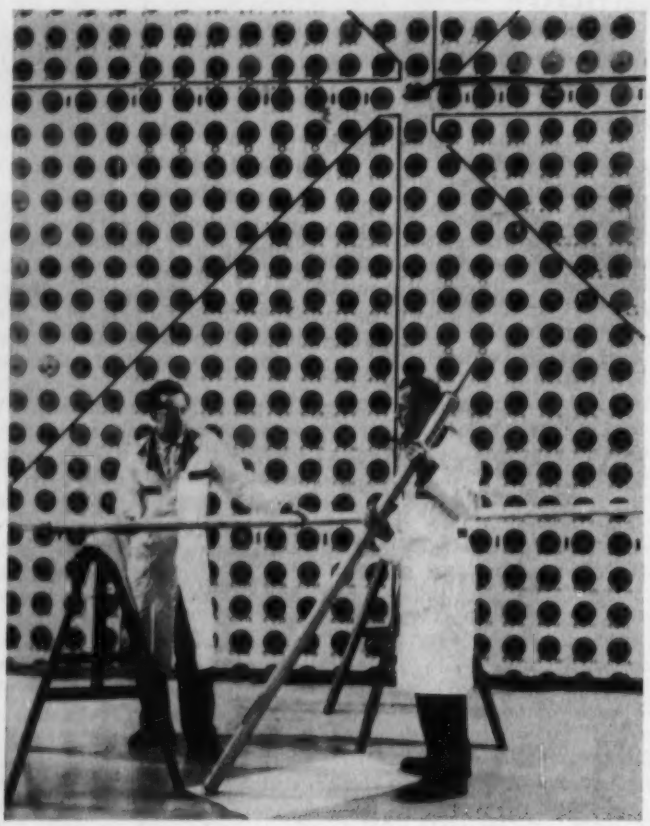
▶**Which Catalyst?**—Opinion is divided as to which catalyst is best.

Aluminum chloride forms a capricious hydrocarbon complex that causes corrosion and handling headaches. UOP, in an earlier process, used $AlCl_3$, now uses platinum. Atlantic, too, cites corrosion problems and higher operating costs due to $AlCl_3$ as basis for preferring platinum, lists an additional advantage for platinum as complete tolerance for water and nitrogen compounds.

On the other hand, with platinum catalysts, separate pentane and hexane reactors are necessary for good yields in large-volume operations, entailing more fractionation facilities. Indiana, using $AlCl_3$, sees no incentive to split fractions and isomerize separately.

Shell also prefers $AlCl_3$, using antimony trichloride, miscible with the $AlCl_3$-hydrocarbon complex, to reduce the catalyst's corrosive activity.

Only UOP boasts nonregenerative operation. Others see no serious disadvantage either in disposing of cheaper catalysts or using an alternate reactor to permit regeneration.



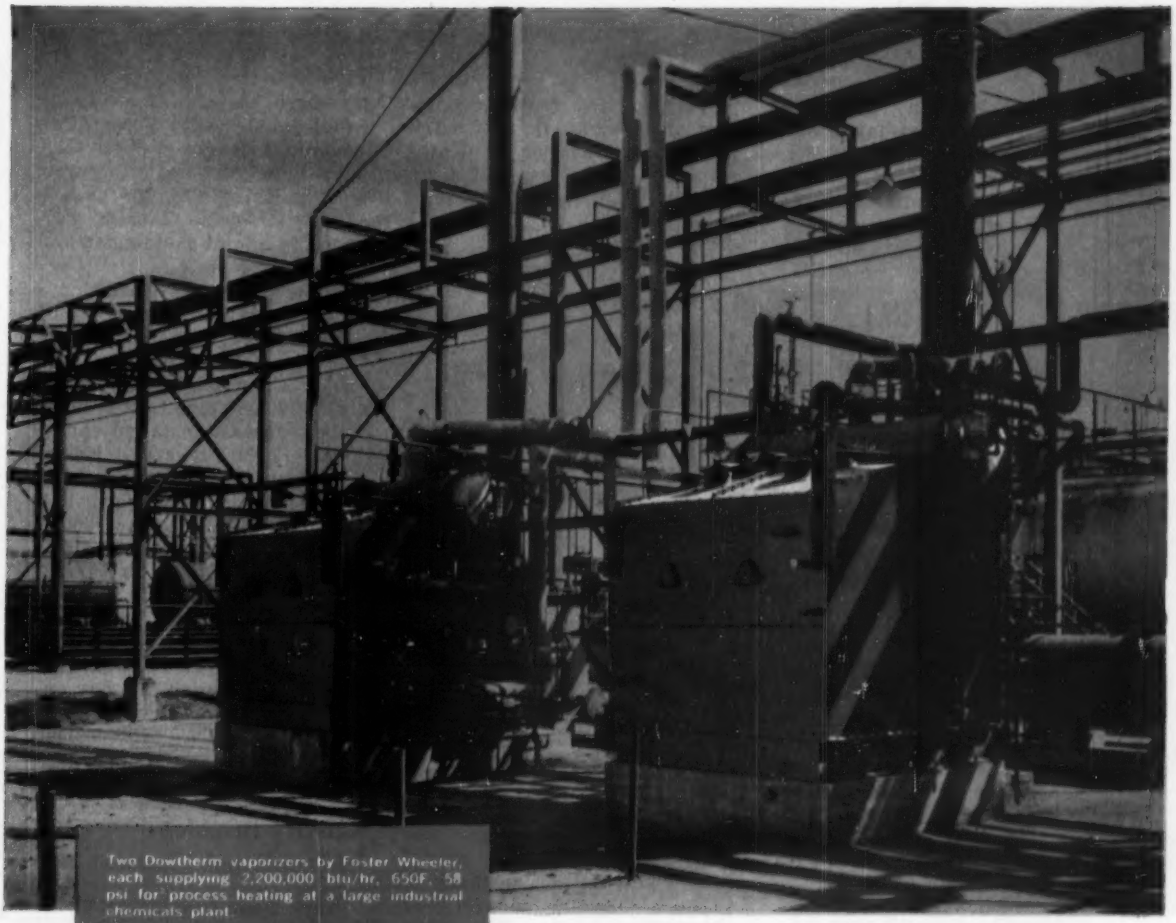
"Loop" Reactor in Atomic Pile Simulates Refining

By means of a "loop" reactor, which permits continuous flow of petroleum samples through an atomic pile at Brookhaven National Laboratory, Upton, N. Y., Atlantic Refining Co. researchers simulate refining conditions under the influence of atomic radiation. Their objective: To find new products and develop full-scale processing techniques.

Loop consists of aluminum tubing encased in a tubular shell which is inserted into the atomic pile. Circulating and automatic control equipment outside pile permit sampling without shutdown.

New Plants Set For Fats and Oils

Spencer Kellogg & Sons plans to start construction next spring on a $5-million soybean and flaxseed processing plant near Breckenridge, Minn. At Hollandale, Miss., Mississippi Cottonseed Products Co. is building a



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filtration-extraction plant to process 140-200 tons/day of cottonseed and 80-130 tons of soybeans.

Second of its kind in the U. S., the Hollandale plant bears witness to the company's successful 2½-yr. operation of a similar 150-ton/day plant at Greenwood, Miss. (*Chem. Eng.*, Sept. 1954, p. 130).

The filtration-extraction process, developed by the U. S. Dept. of Agriculture for small and medium-size mills, requires only rolling, cooking and crisping of the prepared material before actual extraction of the oil with a petroleum solvent. A vacuum filter separates the oil-solvent mixture from the oilseed meal. Remaining operations follow conventional solvent-extraction methods.

To process vegetable oil from rice bran and sunflower seeds, a company in Chile is now building a plant using the filtration-extraction principle.

To produce 2,000 tons/yr. of whale oil and 6,000 tons/yr. of castor bean oil, Detergent, Oils & Fats Industries is building a $100,000 plant in Lima, Peru.

To turn out 25 million lb./yr. of shortenings and edible oils, Procter & Gamble Co. of Canada is building a multimillion-dollar plant near Montreal.

Dow's New Fiber Ready for the Big Time

In about 18 months Dow will complete a plant in Lee Hall, Va., to produce a new fiber said to combine the ease-of-care properties of synthetics with the versatile dyeing characteristics of cellulosic fibers, such as cotton or rayon.

Called Zefran, the new compound is described by Dow as a nitrile alloy. However, indications are that its dye receptivity is due to a vinyl pyrrolidone structure. Many other fiber makers, recognizing pyrrolidone's excellent effect on dyeability, have pondered ways to incorporate it into their products' structures.

Combining these clues to the Dow fiber's chemical identity turns up possibilities like: A polyblend, possibly of a copolymer of acrylonitrile and vinyl pyrrolidone with polyvinyl pyrrolidone; a terpolymer of acrylonitrile, PVP and a third compound.

U. S. Yttrium Moves Productionwards

U. S. Yttrium has awarded a $50,000 contract to Spiegelberg Lumber and Building Co., Laramie, Wyo., for construction of a new plant at Laramie. U. S. Yttrium is engaged in research and development on the production of rare earths of a high degree of purity. The projected plant will utilize some of the existing facilities of the old Standard Oil refinery at Laramie.

New Partners In Aluminum Venture

Olin Mathieson Chemical Corp. and Revere Copper and Brass have formed a jointly owned $231-million company to produce 180,000 tons/yr. of primary aluminum. The move supersedes Olin Mathieson's plans, announced last January, to build an aluminum reduction plant of its own near Clarington, Ohio, with a capacity of only 60,000 tons/yr.

To be called Olin Revere Metals Corp., the new concern will supply two-thirds of its primary aluminum output to Olin, the other third to Revere. Each of the two companies, however, will own half of Olin Revere's stock.

The new company will build at Clarington, in addition to the primary aluminum plant, a 64,000-ton/yr. rolling mill. At nearby Cresap, W. Va., it will build a 450,000-kw. power plant and, at a site on the Gulf Coast yet to be selected, a 350,000-ton/yr. alumina ore-processing plant.

Olin Revere will get its bauxite from ore bodies in Dutch Guiana owned by Billiton Maatschappij. But Olin Mathieson and Billiton are part of an intensive search now going on abroad for new sources of bauxite. Each has signed up as an equal partner with Vereignigte Aluminum Werke, a West German aluminum manufacturer, and Industrie Aktier Gesellschaft, a Swiss bauxite producer, in a joint exploration and mining agreement.

Other new moves in the aluminum picture: Aluminum Co. of America has started construction of a seventh potline at its Point Comfort, Tex., works, adding 20,000 tons to that operation's present installed capacity of 120,000 tons/yr.; Kaiser Aluminum & Chemical Corp. has ordered rectifier equipment valued at $4 million to provide direct-current electricity for two aluminum potlines at its Ravenswood, W. Va., reduction plant; Reynolds Metals Co. has begun operations at an aluminum rolling mill and fabricating plant in in South America at Barranquilla, Colombia, which will produce 300,000 to 400,0000 lb./mo. of aluminum products.

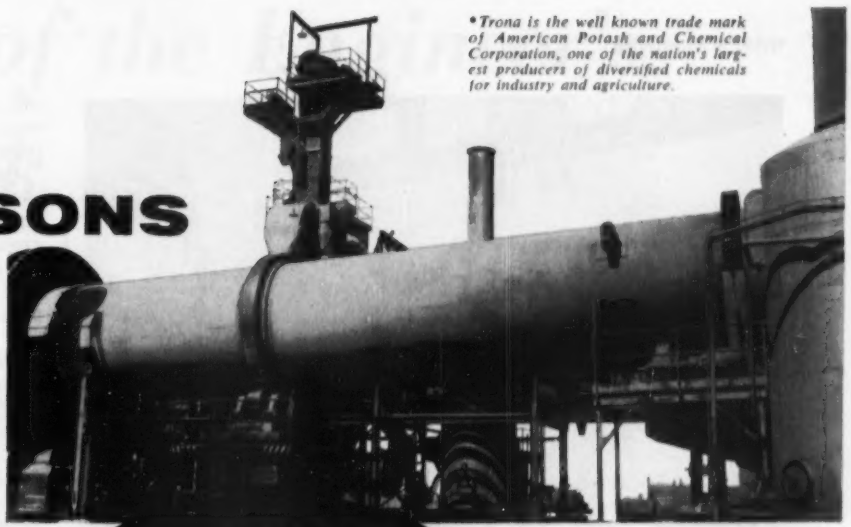
Activity Broadens In Irradiated Plastics

Tape made from polyethylene treated by electronic radiation is now being sold in experimental amounts by General Electric at Pittsfield, Mass., for shielded power cables, motor insulation and communication cable. Called Vulkene 107-E, the plastic is black, heat-resistant and about twice as strong as untreated polyethylene.

One of the pioneers in the commercial development of irradiated plastics (*Chem. Eng.*, June 1954, p. 136; Aug. 1956, p. 122), GE is planning to increase its facilities for making the materials.

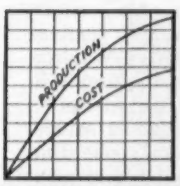
In Birmingham, England, Dunlop Rubber Co. has just completed a specially designed laboratory for the irradiation of rubber and plastics, the first in the British rubber industry. According to E. A. Murphy, Dunlop's director of research, "National-scale development of atomic energy has so enormously increased the availability of sources of radiation that it is now possible to envisage their application on an industrial scale".

9 REASONS



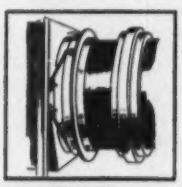
*Trona is the well known trade mark of American Potash and Chemical Corporation, one of the nation's largest producers of diversified chemicals for industry and agriculture.

WHY TRONA* USES STANDARD DRYERS



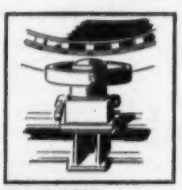
1 HIGHEST PRODUCTION AT LOWEST COST

2 EASY FINGERTIP CONTROL

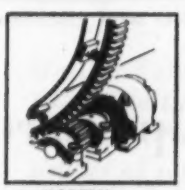


3 METAL TO METAL SEALS

4 COMPLETE CHOICE OF MATERIALS



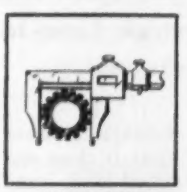
5 RUGGED RUNNING GEAR



6 MODERN SMOOTH DRIVES

7 ANTI-FRICTION BEARINGS

8 DESIGNED TO DO THE JOB



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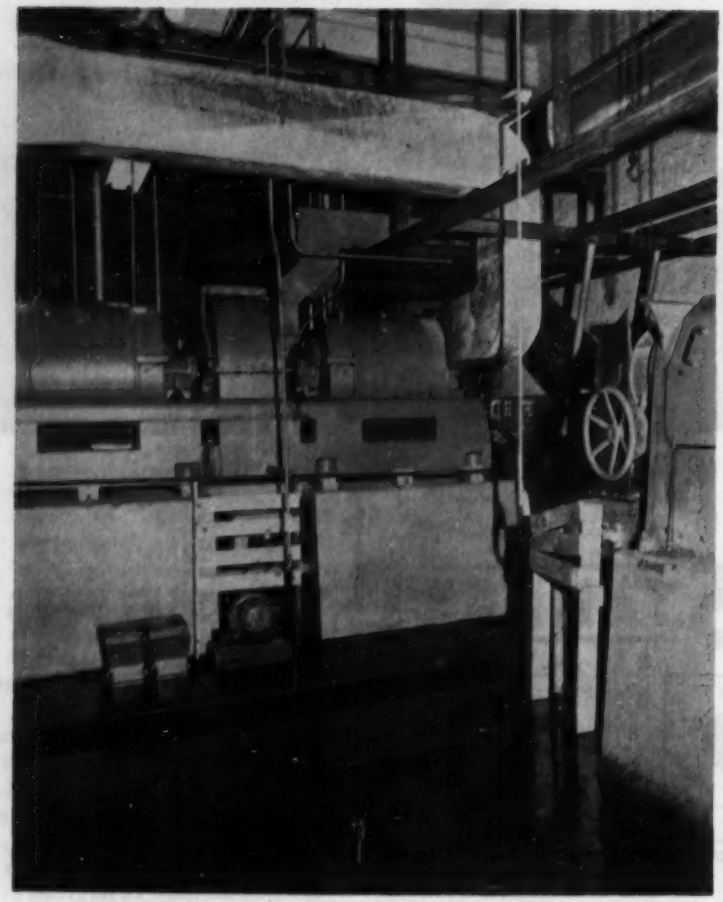


DISK REFINERS have been modified to make groundwood pulp, as . . .

New Process Pulps Hardwoods

Chips substitute for the usual logs in making groundwood pulp, dealing strategic blows to today's twin shortages of newsprint and softwoods.

First in U. S. to produce groundwood pulp from hardwood chips, Gould Paper Co. has just launched the pioneer plant in Lyons Falls, N. Y.

Like Great Northern Paper Co.'s chemigroundwood process put into operation last year at East Millinocket, Me. (*Chem. Eng.*, Feb. 1955, p. 126), the new plant feeds on hardwood, avoids dependence on short supplies of softwoods, usual basis for groundwood pulp. But Gould's process is unique in that it does not require round wood feed, handles any wood—soft or hard—that can be converted to chips.

▶**Free of Logs**—Producers of groundwood pulp, formerly restricted to log feed by the ever-present stone grinders, may now be able to look for a more profitable share in the nation's 200-million-ton/yr. pileup of wood waste. While the new process can take green wood, it also can use dry or frozen wood, so easy to thaw or rewet in chip form, not so in log form.

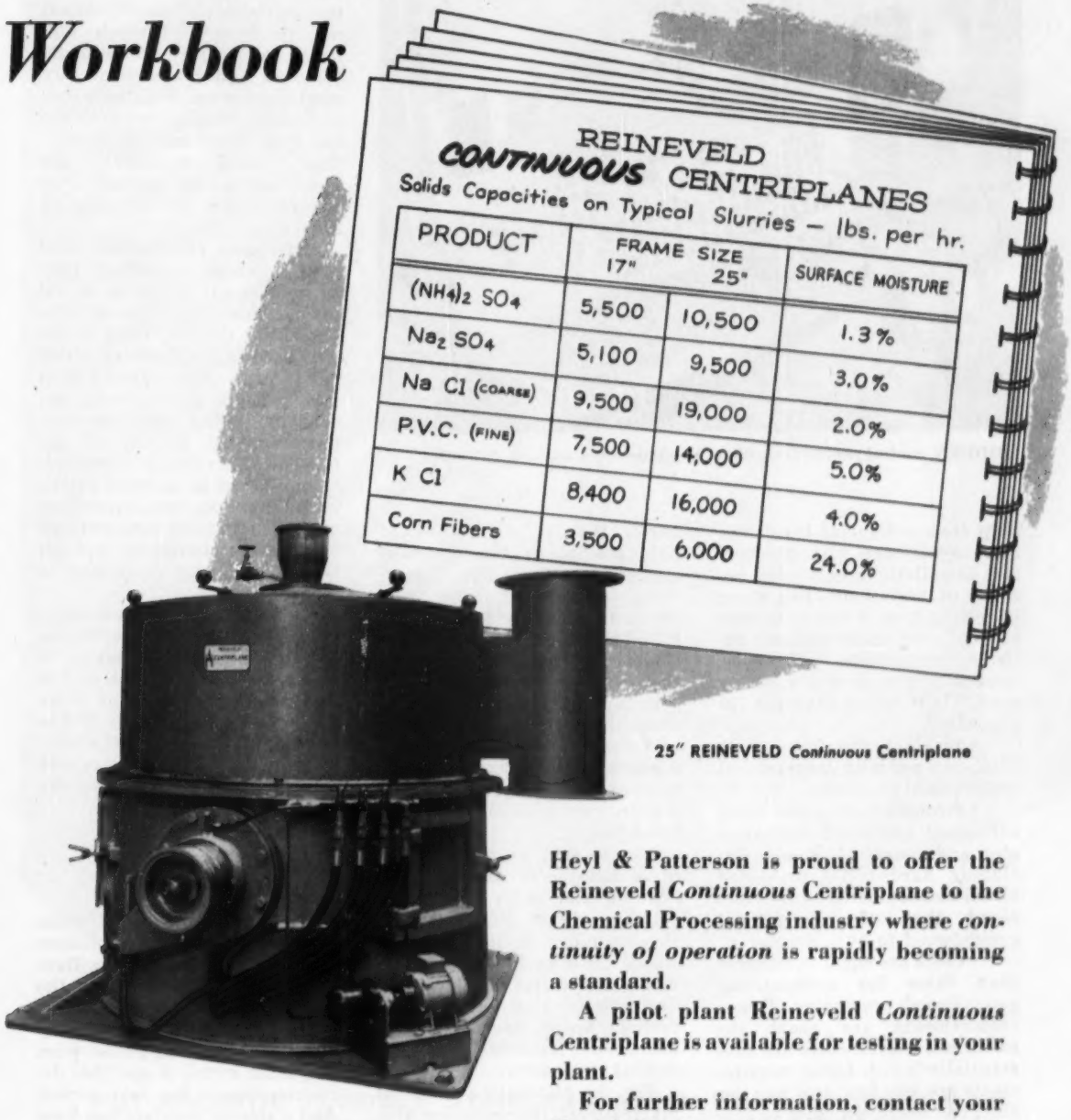
Groundwood-from-chips process harnesses conventional semi-chemical pulping equipment to groundwood pulping problems. Necessity born of the worsening newsprint and softwood shortages has stirred inventiveness of equipment-makers Bauer Bros. and Sprout-Waldron. Each has come forth with a version of the process based on the familiar train of equipment—primary and secondary disk refiners followed by rotary screens and centrifugal cleaners. Chemical cooking is omitted. But for hardwood feed, chemical pretreatment with cold caustic or hot sulfite is substituted.

▶**Pioneer Plants**—The 60-ton/day Gould installation is a Bauer job, using cold caustic on local hardwoods, with pulp going into production of book paper. Coosa River Newsprint Co., Coosa Pines, Ala., which plans an installation combining Bauer and Sprout-Waldron equipment, will be the first U.S. manufacturer to use the process in newsprint manufacture. Sprout-Waldron is shepherding three hardwood-based, cold-caustic-using plants abroad. To start up soon: Associated Pulp & Paper Mill Ltd., with a 17-ton/-day, eucalyptus-based plant in Tasmania to supply pulp for specialty papers; Australia Newsprint Mills Ltd., with a eucalyptus-using mill in Boyer, Australia, producing 28 tons/day of pulp for newsprint; Cartiera Vita Mayer & Co., with a 55-ton/day poplar-using mill in Lonata, Italy, for tissue paper.

In all these cases, groundwood from chips will replace part, but not all, of softwood-derived groundwood pulp in the finished paper. A eucalyptus-based mill slated for Brazil by the Sao Paulo newspaper, *O Estado*, will produce groundwood from chips to supply all the normal proportion of groundwood used in newsprint (i.e., 80%, with 20% made up of sulfite pulp).

▶**Big Potential**—But hopes for the new process are even more expansive than that. Bauer and Sprout foresee the possibility of further reducing, even altogether eliminating, chemical

Out of the Engineer's Workbook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Na2 SO4 5,100 9,500 3.0%
Na Cl (COARSE) 9,500 19,000 2.0%
P.V.C. (FINE) 7,500 14,000 5.0%
K Cl 8,400 16,000 4.0%
Corn Fibers 3,500 6,000 24.0%

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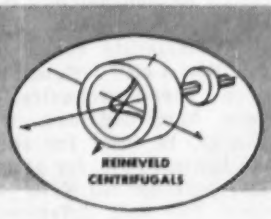

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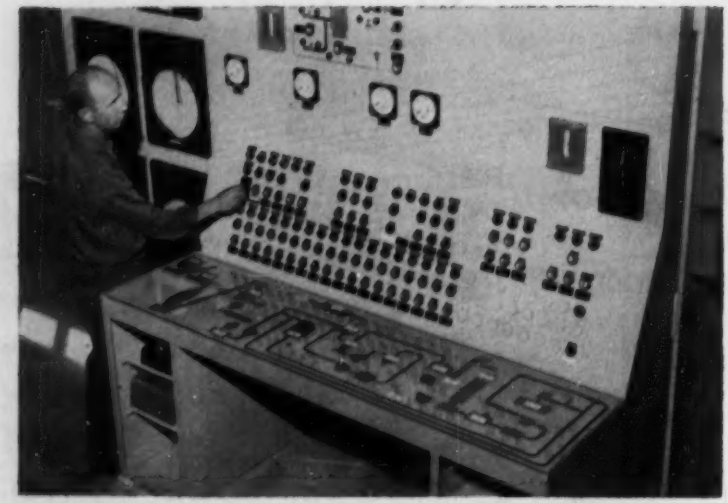


MODERN control center features new groundwood pulping process.

pulp from newsprint furnishes. More experience with commercial installations is needed because of variations—like those in results from different species of wood—which are still not entirely predictable. However, implications of work done so far definitely have far-reaching potential:

- Yields range from 88 to 92%, on a par with conventional groundwood processes.
- Strengths of pulps, both softwoods processed mechanically and marginal woods (including hardwoods) processed chemi-mechanically, range from about that of conventional groundwood to 50% greater.
- Costs are equal to or lower than those for conventional groundwood processing. Power requirements are about the same, and capital costs are substantially lower. Labor requirements are also low; two men per shift can operate a plant to convert chips into cleaned pulp at the rate of 100 tons/day.
- Space requirements are low. It would be possible to install a 100-ton/day mill in 3,500 sq. ft. of floor space.
- Flexibility comes of the fact that a mill designed to produce chemi-mechanical pulp from hardwood can, without change, be used for softwood mechanical pulp, for semichemical pulp or for fully cooked fiber. The only differences between the wide varieties of pulps possible are the degrees of application of cooking chemicals, digestion steam and mechanical energy for refining.

▶Light on Chemicals—The Gould installation, typical of the chemi-mechanical version of groundwood from chips, precedes the basic train of refiners and cleaners with a rapid-cycle digester for cold caustic treatment and a screw press of heavy construction that reduces chips to shives.

For the cold caustic soak, use of a digester is not essential. Soaking the chips in caustic solution (1¼ to 2% NaOH on the oven-dry weight of the wood) for 2 hr. in an open tank would suffice. But the digester is desirable for simplicity of processing, lower space requirement, lower labor cost and lower capital expenditure.

For the alternative chemical pretreatment, impregnation with hot sodium sulfite, either a rapid-cycle digester or some adequate equivalent is essential. Impregnation takes place at pressures of 100 psi. or higher with liquor (about 6% Na_2SO_3 on the oven-dry weight of the wood) at temperatures above the boiling point.

▶Enter Chip-Fed Press—The high-pressure press is the one unit in groundwood-from-chips process that is new to the paper industry. Its design is similar to that of presses used in the vegetable oil industry to expel oil from cottonseed, soybeans and the like. Both Sprout-Waldron and Bauer Bros. are marketing presses to the paper industry. Called, respectively, the FiberPress and the Pressafiner, both machines are manufactured by specialists in equipment for the vegetable oil industry.

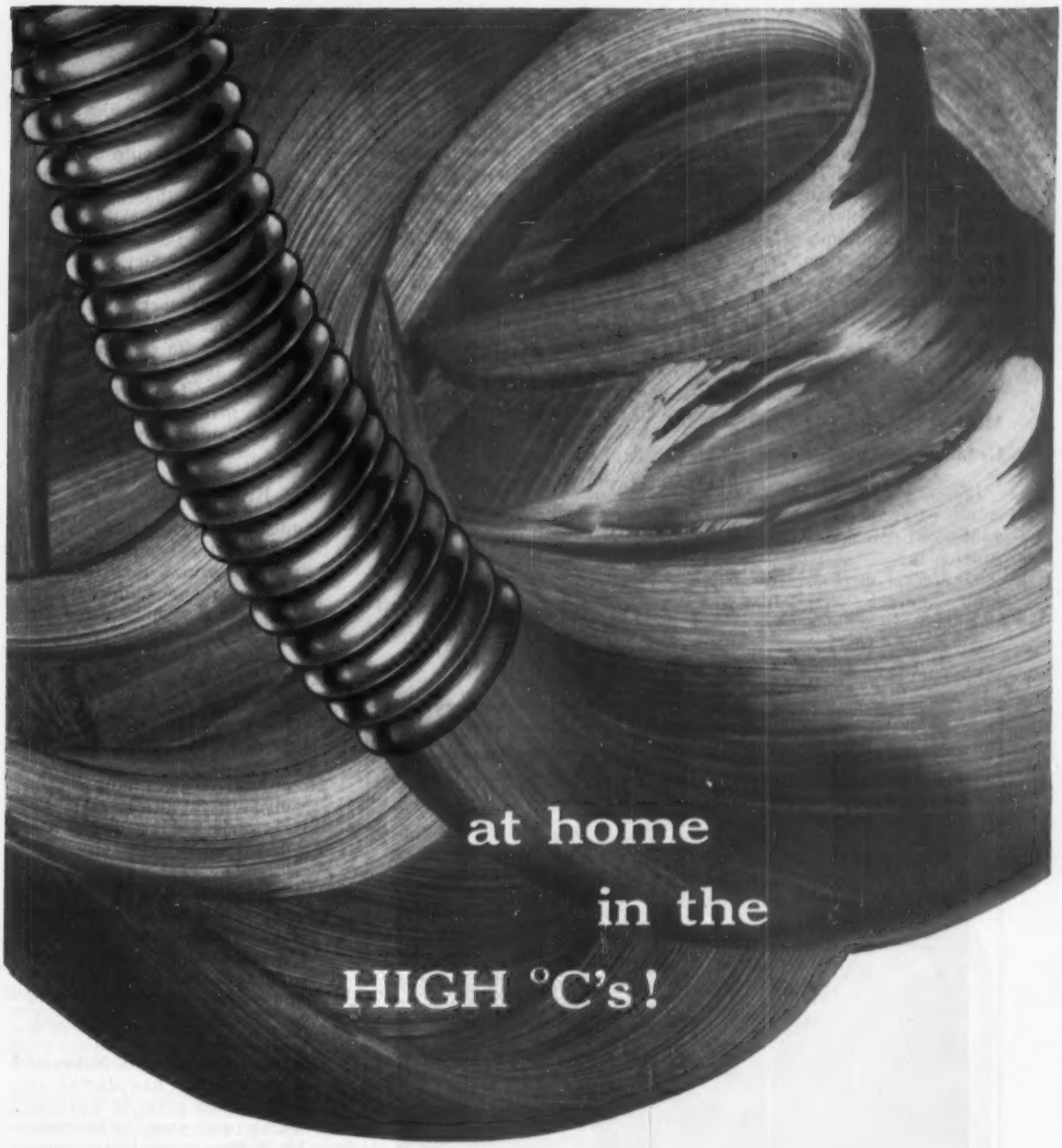
In the past, pulpers have used presses which can accept pulp to squeeze out liquor as an aid to chemical recovery or disposal. But the new press is the first used in the industry which can accept chips. This ability may make a place for it, not only in groundwood-from-chips processes, but in any of the partial-cook pulping processes. Chemicals can be squeezed out directly after the cook while they are still relatively concentrated because the charge has not yet been diluted for treatment in the refiners.

For the groundwood-from-chips process, the press can be set so that pressing action is reduced and fiberizing action is emphasized. It is a means of reducing pulp to a form resembling groundwood rejects which, when properly refined, produce a pulp stronger than regular groundwood pulps.

AEC Signs Up Beryllium Suppliers

A contract with total value estimated at over $23 million has been awarded to Beryllium Corp., Reading, Pa., by the Atomic Energy Commission. Requiring the production of 500,000 lb. of nuclear-grade pure beryllium metal, it specifies deliveries over a five-year period. And a similar contract has been awarded to Brush Beryllium Co., Cleveland.

As a result, Beryllium Co. will add to existing Reading facilities with a new $4-million plant, site as yet undecided. For Brush, the contract means a new plant at Elmore, Ohio, from which deliveries are scheduled to begin early in 1958. Until then, production of a government-owned plant in Luckey, Ohio, operated by Brush, will continue. (*Cont'd*)



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Methyl Methacrylate Gets New Producer

In quick succession—inside a month—Hercules Powder Co. has announced new endeavors or expansion in:

• *Methyl methacrylate*—The joint venture with Imperial Chemical Industries, Ltd., to build a $30-million, 35-million-lb./yr. plant at Louisiana, Mo., will bring to Hercules: ICI's 20 years of experience with the material; to ICI: Hercules' know-how in U. S. production and marketing methods. The new combine brings a third producer into a market previously shared in the U. S. only by Du Pont and Rohm & Haas. Site is handy to raw materials: Natural gas from nearby pipelines from Texas oil fields; ammonia and methanol are produced at the site; acetone will come from Hercules' Gibbstown, N. J., plant. Methyl methacrylate consumption is expected to double in the next five or six years.

• *Tall oil fractionation*—Two new fractionation plants—at Franklin, Va., and Savannah, Ga.—will yield 115 million lb./yr. of rosin and fatty acids. The flexible distillation columns are "tailored to meet the demands of existing markets," Hercules says. Crude tall oil will be obtained from nearby kraft pulp mills.

• *Oxychemicals*—An expansion program at the Gibbstown, N. J., plant will double production of para-cresol and its derivatives. An earlier addition scheduled for completion late this month or November: Facilities for 3 million lb./yr. of para-cresol and for its conversion to ditertiary butyl para-cresol. Para-cresol is fast growing in its use in making synthetic hormones and antioxidants.

Clarifiers to Slake a 3,000-Gal./Min. Thirst

To supply process water for Tidewater Oil's new 130,000-bbl./day refinery near Wilmington, Del., big water treatment plant will process 3,000 gal./min. Including facilities for filtering and chemical treatment, demineralizing and zeolite processing, the plant supplies water for the refinery's power plant, refining units and general facilities, including drinking water.

Entirely separate facilities pump 275,000 gal./min. of Delaware River water to cool refinery equipment.

News Briefs

Magnesium-thorium alloy: Dow Chemical Co. is now turning out commercial quantities of a new magnesium-thorium alloy which can be used in high-temperature aircraft. It is said to have excellent corrosion resistance and, because of its light weight, can be used in thicker sections than heavier metals.

Zirconium: Wah Chang Corp. will build a zirconium chlorination and reduction plant at Albany, Ore.

Titanium: Titanium Metals Corp. of America, Henderson, Nev., will increase capacity for output of titanium sponge to 25 tons/day from 16.7 tons and output of titanium ingots to 30 tons/day from 17 tons.

Organic specialties: National Aluminate Co. has started up a $1-million plant in Chicago which will eventually make 50 different products—some basic organics, some blends such as slimicides, antifoamants, corrosion inhibitors.

Paper: Construction has begun on a $50-million pulp and paper mill at Lepreau, New Brunswick, Canada. Cosponsors of the project are said to be Sir Robert McAlpine & Sons, London, and Butler Co., Chicago.

Cement: Production has started at Saskatchewan Cement Corp.'s $8-million, 2,500-bbl./day plant in Regina.

FM

Factory Mutual Approved

New ASCO SAFETY SHUT-OFF VALVE provides tight seating... large flow capacity

Important design features of this new ASCO valve — absolutely tight seating on gas — and large flow capacity — ideally suit it for use as a safety shut-off valve on gas and oil fired furnaces, ovens and boilers.

This new ASCO Solenoid Valve, Bulletin 8022, assures safe operation because its globe type seating, with integral crown type seat and soft composition disc, tightly seals off gas or oil. A unique combination — Y type body and oversize port (in 1¼"-3" sizes) provides flow almost equal to that of a "straight through" gate valve. Factory Mutual Laboratories has approved the Bulletin 8022 in 1¼"-3" sizes for handling manufactured, natural, and L-P gases in maximum ambient temperatures of 104° F. Valves can also be used for fuel oil and non-corrosive liquids and gases.

This free handle valve must be manually opened — it can only be opened and remain in the open latched position when the solenoid is energized. When the solenoid is de-energized, the valve will trip closed.

Important announcement . . . *new ASCO plant now being built in Florham Park, N. J. will double production capacity and greatly extend the range of our research, product development and services.*

- **Dependable Control by ASCO.**

  The ASCO Bulletin 8022 comes in sizes ¾" through 6", with pressures ranging from 25 to 150 p.s.i. It has been designed to permit mounting in any position. This eliminates piping problems that occur with valves that must be mounted in one position. Valves are available with general purpose, watertight or explosion-proof solenoid enclosures to meet any requirements.

  For further information, write for ASCO Bulletin 8022. Or call the ASCO Engineer. He can give you full data on this valve, and on ASCO's complete line of 2, 3, and 4 way solenoid valves.

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Apparently the Caustic Soda Buyer's Guide fills a need

This pocket-size compendium of useful facts on caustic soda has proved so popular and useful we've ordered a second printing.

Besides much basic information on forms and grades, containers and shipping methods, the *"Guide"* treats of such diverse subjects as these:

- Comparative economics of 50% and 73% liquid caustic soda. An unbiased report on the advantages of both strengths with both a table and nomograph to help you figure quickly if there are any possible savings for you with the 73% liquid.
- The amount of liquid caustic of a given strength you must have to develop various process concentrations. Another nomograph helps you figure your needs in minutes.
- Some points to ponder before you choose a supplier of heavy chemicals.

Get a copy of this second edition for your use. Check the coupon on the next page.

New data sheet on Caustic Potash

We have just completed a data sheet on NIALK® Caustic Potash—one of the newest members of the Hooker roster of chemicals.

We believe you'll find that the new specifications measure up in every way to the high NIALK standards of the past.

If you use caustic potash and purchase other Hooker chemicals such as caustic soda, it might pay you to look into the possible savings of a consolidated source of supply.

You can get NIALK Caustic Potash in standard and low-chloride grades, in 45% to 52% liquid solutions; and in the following solid forms, as 90% and as 85% (low chloride) material: solid, flake, granulated, broken, crushed, powdered, and walnut.

The liquid forms are shipped in tank cars of 4,000 to 10,000-gallon capacity. Solid forms are shipped in steel drums.

To keep your file up-to-date, send for the new data sheet. Just check and mail the coupon.

K_2CO_3 as you like it

No matter how you use carbonate of potash in your processing, you're sure of the *right* form when you specify NIALK Carbonate of Potash.

That's because we make it in these *five* forms:

1. Hydrate regular (granular) 83.5% to 84.0%
2. Calcined regular (granular) 99.2% to 99.6%
3. Calcined powder 99.2% to 99.6%
4. Powdered ..... 91.0% to 94.0%
5. Liquid ..... 48% to 52%

For details on the form that meets your needs best, use the coupon to request technical data.

How long can you store Sodium Sulfhydrate?

A while ago a customer of ours came across some Hooker sodium sulfhydrate which he had stored accidentally for over four years.

It looked OK, so he used it.

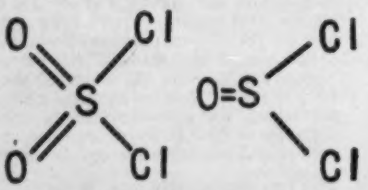
Results? "Excellent," says he. No apparent iron contamination in four years!

Such long-lived purity is no accident when you buy Hooker sodium sulfhydrate.

We package sodium sulfhydrate in brand-new steel drums with a 1/64-inch lining of lacquer to prevent iron pick-up. We lacquer the drum lid, and secure it with six sturdy lugs so it stays airtight until you break the seal.

Extra caution is used before the sodium sulfhydrate goes into the drum, too. We control raw materials rigidly by using only our own caustic soda and hydrogen sulfide.

That's why you always get a product that dissolves swiftly into pure, sediment-free solutions when you specify Hooker sodium sulfhydrate.



Want to chlorinate or sulfonate?

In many cases you'll find it's easier and safer to work with Hooker sulfuryl chloride or thionyl chloride than with pure chlorine or sulfur.

To our best knowledge, we alone manufacture these chemicals in commercial quantities. Both make ex-

Carbonate of Potash • Sodium Sulfhydrate

Trichlorethylene • Chlorofluorocarbon Compounds

cellent chlorinating agents. Either may be used to introduce sulfur or oxygen and sulfur.

Hooker sulfuryl chloride is 99+% pure. You can get Hooker thionyl chloride in two grades—the technical grade is 93% min. pure, the refined grade 97.5% min.

Two simpler chlorinating agents. You can also purchase sulfur monochloride and sulfur dichloride from us. The monochloride (technical grade) has a chlorine content of 52 to 52.5%. The dichloride is 66% chlorine.

You can get complete technical data on any of these compounds by checking the coupon.

Nialk® Trichlorethylene—extraction, technical, and X-1 grades

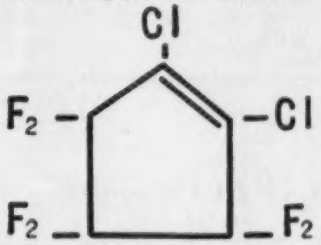
You can now purchase trichlorethylene from Hooker in several grades under the NIALK brand name.

Technical Grade has no HCl acidity and a maximum of 0.001% alkalinity as NaOH. It boils at 86.6 to 87.8° C at 760mm. Used as a freezing-point depressant in carbon tetrachloride fire extinguisher fluids, as a solvent in various adhesive formulations, and in similar applications.

Extraction Grade has no HCl acidity. Its alkalinity as NaOH is .006 to .008% maximum. It boils at 86.6 to 87.4° C at 760mm. Used for extracting fats from animal matter, oil from raw wool, cottonseed, flaxseed; has pharmaceutical and other uses.

X-1, a special grade, is available for those uses requiring a product of exceptionally high quality.

Send for bulletins. Technical Data Sheet No. 787 gives a resumé of important information on all grades. For more detailed information on NIALK Trichlorethylene and its uses, send for Bulletin No. 44, a 40-page booklet covering physical and chemical properties, shipping containers, safe handling procedures, etc.



Can you use this chlorofluoro compound?

One glance at the double bond and the unique combination of chlorine and fluorine in this new Hooker chemical — 1,2,-Dichlorohexafluorocyclopentene-1—tells you something of its potential.

Attack that bond and you can develop dozens of useful, highly fluorinated compounds that contain functional groups.

Oxidize to perfluoroglutaric acid, for example, and you can derive the acid halide, amide, esters, alcohols, and the anhydride—derivatives which might be useful in the development of polyester and polyamide resins, hydraulic fluids, elastomers, and wetting agents.

And these are only a few of the possible reactions!

Three other new chlorofluorocarbons. Here are the names and formulas of three other promising compounds recently developed:

2,3-Dichlorohexafluorobutene-2
CF_3-CCl=CCl-CF_3

2,2,3-Trichloroheptafluorobutane
CF_3-CCl_2-CFCl-CF_3

2,2,3,3-Tetrachlorohexafluorobutane
CF_3-CCl_2-CCl_2-CF_3

Data and samples. You can get the chemical and physical properties of these compounds, with typical reactions, and suggestions for possible applications and areas of research, by checking the coupon for data sheets.

Samples of these chemicals are available at a nominal price covering cost of manufacture.

HOOKER ELECTROCHEMICAL COMPANY
411 Forty-seventh St., Niagara Falls, N. Y.

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

HOOKER CHEMICALS PLASTICS

6-1946

For more information on chemicals mentioned here, check below:

- ☐ *Caustic Soda Buyer's Guide*
- ☐ Caustic Soda (Technical Data Sheets)
- ☐ NIALK Caustic Potash
- ☐ NIALK Carbonate of Potash (Bulletin)
- ☐ NIALK Carbonate of Potash (Technical Data Sheet)
- ☐ Sodium Sulfhydrate
- ☐ Sodium Sulfide
- ☐ Sulfuryl Chloride
- ☐ Thionyl Chloride
- ☐ Sulfur Monochloride
- ☐ Sulfur Dichloride
- ☐ Chlorinating Agents (Bulletin No. 328A)
- ☐ NIALK Trichlorethylene (Bulletin No. 44)
- ☐ NIALK Trichlorethylene (Technical Data Sheet)
- ☐ 1,2-Dichlorohexafluorocyclopentene-1
- ☐ 2,3-Dichlorohexafluorobutene-2
- ☐ 2,2,3-Trichloroheptafluorobutane
- ☐ 2,2,3,3-Tetrachlorohexafluorobutane

Clip to your letterhead with your name and title, and mail to us. *When requesting samples, please use business letterhead to help speed delivery.*

EDITED BY R. K. GITLIN

Properties of new polyethylene vs. conventional poly

	ASTM Test	Poly-Eth Hi-D	Conventional Polyethylene
Density	D 792–50	0.935–0.940	0.918
Nominal melt index, g./10 min.	D 1238–52T	1	1
Ultimate tensile strength, psi	D 412–51T	2,300	1,850
Yield tensile strength, psi	D 412–51T	2,300	1,200
Elongation, %	D 412–51T	400	575
Stiffness, 73 F., psi	D 747–50	35,000	13,000
Shore hardness	D 676–49T	D 57	D 44
Softening point, Vicat F.	———	235	200
Brittleness temperature, F.	D 746–52T	<−100	<−100
Impact strength, Izod Notched, 73 F., ft.-lb./in. notch	D 256–54T	didn't break	didn't break
Power factor	D 150–47T	<0.0003	<0.0003
Dielectric constant	D 150–47T	2.3	2.3

High-Density Poly Via High Pressure

Exhibits significant improvements over conventional and intermediate-density material.

The first commercial quantities of a new high-density polyethylene molding resin produced in a high-pressure type plant are now being produced by Spencer Chemical Co.

While retaining the desirable non-toxic and odorless properties usually associated with polyethylenes from the high-pressure process, the new resins exhibit greater stiffness and strength, higher heat resistance and less permeability than standard- or intermediate-density polyethylene.

Here are some of the highlights of Poly-Eth Hi-D resins:

• Higher heat resistance—Enables articles to withstand easily temperatures of boiling water without deformation. Thus, an odorless, non-toxic polyethylene can be used for housewares, bottles, etc. subject to high temperatures beyond the reach of standard poly.

• Improved rigidity and tensile properties—Increase dimensional stability of molded products and will permit, in some cases, economical reduction in wall thickness without corresponding loss in strength.

Spencer feels that its new resins will fill a gap in the range of polyethylene properties which, until now, has existed between resins produced from established high- and low-pressure processes. Thus, the plastics trade will have available a variety of polyethylene grades which may be tailored to specific types of end use applications.—**Spencer Chemical Co., 610 Dwight Bldg., Kansas City 5, Mo.** 142A

Thickening Agent

To be used with paints, varnishes, plastics, protective finishes, etc.

Imperviousness to the effects of impurities (water, phenols, polar solvents, basic or acidic components) plus uniform viscosity over long aging periods give Viscotrol-A the edge over many other thickening agents.

In addition, this white organic powder increases and controls viscosity; controls sagging and flow; prevents pigment settling; improves brushability; controls penetration; provides better leveling characteristics; won't affect drying rate, scratch resistance, adhesion, color, gloss or other properties attributed to good finishes.

Among Viscotrol-A's many potential applications are:

• Paints—Imparts such desirable properties as thixotropic body pigment suspension, anti-sag, improved brushability, penetration control.

• Caulking compounds—Slippery gel-like consistency of caulking materials compounded with Viscotrol-A makes for easier, more uniform extrusion from the gear; prevents sagging; lends a stay-put quality; prevents bleeding of caulk vehicle into adjoining surfaces.

• Inks — Small amounts added to pigment grind give sharp definition to silk screen, textile, lithographic and linoleum inks. Thixotropic action prevents running, feathering, pigment settling and controls penetration into porous surfaces.

• Cosmetics and pharmaceuticals—Ability to thicken organic liquids is useful in giving oils an ointment or salve consistency.

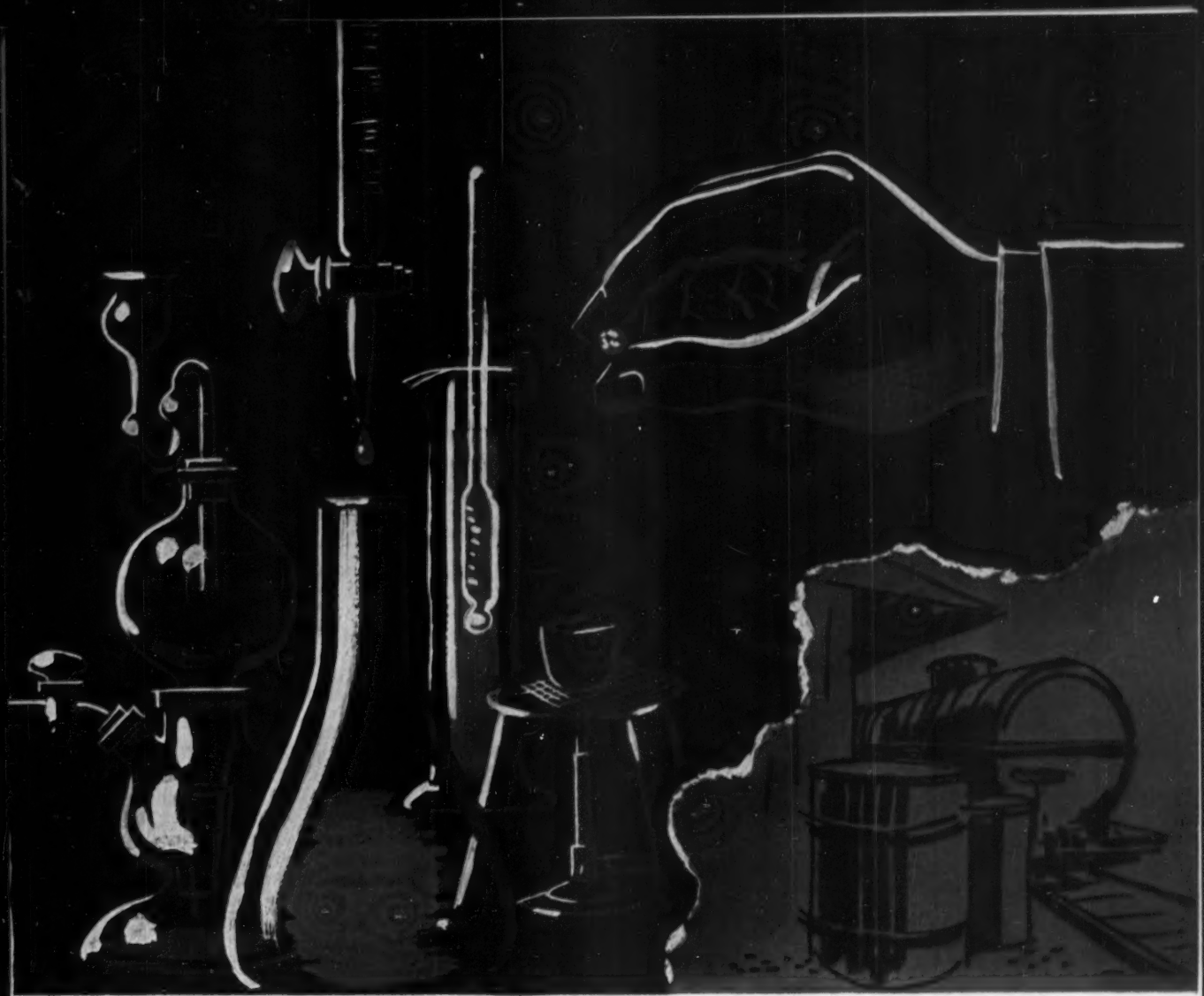
Other suggested uses include lubes, adhesives, polyesters, epoxy resins, insecticides.—**Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio.** 142B

Compressor Lubricant

Fire-resistant, minimizes carbon deposition.

Pydraul AC, latest in Monsanto's series of Pydraul fire-resistant fluids, is a synthetic air compressor lubricant which not only minimizes explosions and receiver fires, but also has a marked ability to reduce carbon deposits on exhaust valves and air system piping. Advantages: Important maintenance savings plus a wide safety margin in compressed air systems.

Conversion of compressors from petroleum lubes to Pydraul AC is simple. Splash-lubricated compressors need only be cleaned of their petroleum deposits before installing the new fluid. Separate force-feed lubricators can be converted with modifica-



Quality in chemicals is a lot of little things

The drop at the end of a burette--a specific gravity reading--a crystal under the microscope, or the weight of ash in a crucible--these are a few of the little things that add up to the final quality in an industrial chemical.

It is the constant attention to such control details that has given Heyden Organic Chemicals their high standards of quality and dependability through more than 50 years of service to industry and research.

Heyden Organic Chemicals--through continuing research and advanced manufacturing methods--have grown steadily in number, volume and applications. They comprise both aliphatics and aromatics, including large volume basic raw materials for many major fields --surface coatings, drugs and cosmetics, textiles, plastics and dyestuffs--and other organic intermediates.

Why not consult our technical or sales staff on your particular requirements? We'll welcome the opportunity to work with you.

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High-density poly via high pressure.....142A
Thickening agents for paints, plastics....142B
Fire-resistant compressor lubricant.....142C
Three new water conditioners.....144A
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Ultra-pure silicon 148B
Fire-retardant mastic.....150A
95% pure neodymium oxide.....150B
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Multipurpose lubricant 150D
Whitening agent for acrilan.....150E
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Tall oil monobasic fatty acids.....150I

Page number is also Reader Service code number

For more about any item, use Reader Service Card

tion kits available from major lubricator manufacturers.

The new synthetic lube has already been tested and approved by more than 30 companies, particularly in petroleum refineries, gas pumping stations, power generating plants, etc.—**Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.** 142C

Water Conditioners

Control scale, algae, equipment corrosion in cooling tower systems.

Three major water problems plaguing operators of cooling tower systems in maintaining the efficiency of air conditioning and refrigeration units are scale, corrosion and algae.

Scale in the condenser lowers heat transfer which in turn raises the temperature of the refrigerant gas. Net result: Increased power costs and lower capacity. Corrosion reduces the life of the equipment. Algae reduces heat transfer, restricts water flow.

To combat these headaches, Calgon has introduced three water treatment products—Calgon Scale Remover, Micromet Plates and Calgon Algaecide.

• Scale remover—Used to clean systems in which scale is already present. Main features include a built-in pH color indicator (causes color change in water when acid scale remover solution is almost neutralized and too weak for rapid cleaning), corrosion inhibitor, wetting agent and antifoam.

• Micromet — Phosphate chemical which, with proper bleed, prevents build-up of lime scale. Available in slowly soluble plate form. Plates are put in a plastic-coated glass mesh feed bag in the tower, preferably above the sump water under the water droplets so they will be wet and will dissolve just when the system is operating. An initial charge of ½ lb. plates per ton of capacity inhibits scale formation, will last about six months.

• Algaecide—Periodic doses keep slimy growths under control.—**Calgon, Inc., 423 Fourth Ave., Pittsburgh, Pa.** 144A

Automotive Paint

Synthetic enamel eliminates drying time between coats.

"Revolutionary" is the tag given to Dythol quick-drying auto paint by its manufacturer, Martin-Senour Paint Co.

What makes this synthetic enamel unique is that it air dries in just 30 minutes, thus:

• Allows auto refinishing shops to apply two coats in immediate succession with no long drying time between coats.

• Puts small shops in a better position to compete with larger shops. Autos can be refinished and wheeled out of the shop, dust-free, in one hour.

Dythol doesn't contain nitrocellulose, nor is it a lacquer. But it's almost as fast as a lacquer in drying rate and much faster than today's synthetic enamels. Secret of its success is a new, but as yet undisclosed, copolymer resin.

Price — $1.50/gal. — is about 15-20% higher than conventional synthetic enamels, on a par with lacquer costs. But this is more than compensated for by auto shops' time and labor savings, some of which can be passed on to the customer.—**Martin-Senour Paint Co., 2520 Quarry St., Chicago, Ill.** 144B

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Antifoam Agent

Solves foaming problems in continuous diffusion.

Excessive foaming in continuous diffusers often reduces diffusion efficiency, provides a breeding place for bacteria, presents a safety hazard for men working around the machinery. (It may even lift the covers right off the diffusers.)

To combat these problems, Hodag Chemical Corp. has introduced a new antifoam compound labeled Hodag BX-108.

Formulated to work efficiently in the higher temperatures of

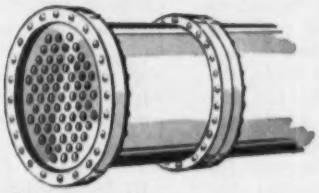
Biscuit baking...

Leavening

leather tanning...

Neutralizing

gypsum removal...



Scale removal

each uses a different property of

SOLVAY AMMONIUM BICARBONATE

WHICH OF THESE PROPERTIES CAN YOU USE?

Physical and Chemical Properties

Molecular Weight: 79.06

Solubility in Water: 14% at 10°C., 17.4% at 20°C., and 21.3% at 30°C.—Insoluble in alcohol.

Negative heat of solution

Stability: Relatively stable at room temperatures.

Volatility increases sharply above 140°F.

Decomposition product ratios are as follows:

Ammonia gas (NH_3).....21.5%

Carbon dioxide gas (CO_2).....55.7%

Water vapor (H_2O).....22.8%

pH of 1/10 N solution at 25°C.: 7.8

Appearance: White Crystals

Quality: Exceptionally pure. Food grade.

Very low metal content.

The leavening of thin-baked goods, the neutralization of strong leather-making acids and the removal of gypsum from processing equipment are typical of the many and diverse processes that have adopted properties of SOLVAY Ammonium Bicarbonate. These properties include the economical and complete volatilization to a nontoxic gas at low temperatures and without residue. Its solutions have lower pH and yet greater neutralizing ability than certain competitive alkalies. It also provides a dry, crystalline source of ammonia for packaged cleaning compounds.

Whether your need ranges from a material to create voids, to mild neutralization of acids, or to a dry source of ammonia for household cleaning compounds—check the properties of SOLVAY Ammonia Bicarbonate.

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ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

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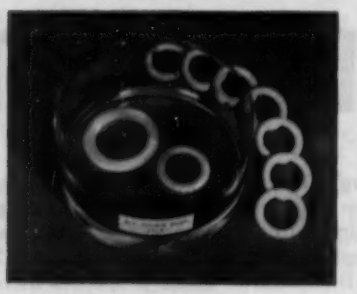
Aluminum Chloride • Vinyl Chloride • Calcium Chloride
Potassium Carbonate • Sodium Nitrite • Caustic Potash
Snowflake® Crystals • Sodium Bicarbonate • Caustic Soda
Ammonium Chloride • Methylene Chloride • Methyl Chloride
Ammonium Bicarbonate • Ortho-dichlorobenzene • Chloroform
Soda Ash • Monochlorobenzene • Carbon Tetrachloride • Para-dichlorobenzene
Chlorine • Cleaning Compounds • Hydrogen Peroxide

continuous diffusers, the new agent is based on specially fractionated edible vegetable oils. Because it's heat treated, it's low in bacteria content. Odor is bland; color, dark amber; weight, 7½ lb./gal.

Used diluted or applied direct, BX-108 is a free-flowing liquid that requires no heating before application. It's easy to handle in automatic systems, can be closely regulated, doesn't clog drip valves. According to the manufacturer, it's stable for long storage periods and is effective in small concentrations.

Though specially designed for foam control in continuous diffusers of sugar beet plants, BX-108 is also applicable to other food and chemical processing operations. — **Hodag Chemical Corp., 7247 N. Central Park, Chicago 45, Ill.** 144C



Silicone Rubbers

One fluoro-silicone, one foam, five vinyl silicones.

There seems to be no let-up in silicone rubber activity, witness the bevy of recent announcements concerning seven new compounds—one from Dow Corning, one from Connecticut Hard Rubber, five from Union Carbide and Carbon.

• Dow Corning's new heat-resistant rubber is said to be a major step toward the Air Force's goal of a low-swell, heat-stable rubber for use on jet powered planes.

Known as Silastic LS-53, it is a molecular hybrid combining the best properties of silicone rubbers and fluorocarbon plastics—i.e., ease of fabrication of silicone rubbers with the solvent resistance of fluorocarbons.

For the present, Silastic LS-53 will be limited to essential aircraft applications: O-rings and other seals where rubber must perform over a temperature range from −80 F. to over 400 F. and still resist swelling and attack by gasoline, jet engine fuels, hydraulic fluids and engine oils.

An indication of the new rubber's performance can be seen in the above photograph. After 24 hours' immersion in JP-4 jet engine fuel, a conventional silicone rubber O-ring swelled to over double its original size while an identical LS-53 ring remained almost unchanged.

Fabricators used to handling conventional silicone rubbers will find no difficulty in making parts of Silastic LS-53. Its hardness, tensile strength and elongation are comparable to good, all-purpose silicone rubbers.—**Dow Corning Corp., Midland, Mich.** 146A

• Connecticut Hard Rubber's COHRfoam is a lightweight silicone foam rubber which remains soft and resilient over a temperature range of −100 F. to 480 F.

Because of its interconnecting cell structure, COHRfoam recovers its shape instantly after being compressed for long periods at high temperatures. Typical of silicone rubber, it's inert to ozone and weathering, non-sticking, non-corrosive, odorless, tasteless, has excellent electrical properties.

Current use: Airframe seals where no other material has operated successfully. Anticipated uses: sound and vibration packing, electrical and thermal insulation, mechanical sealing large, light seals.

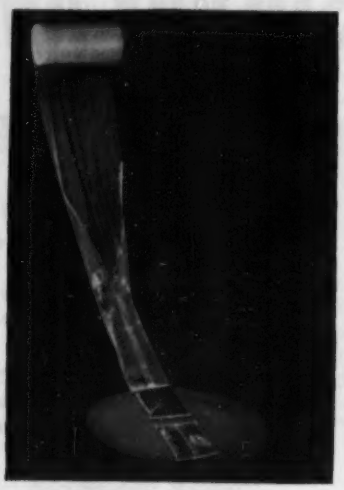
Initially COHRfoam will be offered in sheets and custom moldings up to 8-in. thick.—**Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.** 146B

• Union Carbide and Carbon's five pre-conditioned vinyl silicone rubber compounds—K-1044R, K-1045R, K-1046R, K-1047R and K-1048R—are designed to meet the toughest aeronautical specs for high-temperature applications.

They're described as pre-conditioned because the manufacturer ships them in such a condition that they're easy for the fabricator to process. Just a few turns of the mill will process the compounds to a freshened state ready for fabricating; this sometimes takes less than a minute.

Other features of the K-1040 series include controlled reactivity, high tear, high elongation, tensile strength of over 800 psi., low compression set, good oil resistance, low moisture absorption, good dry and wet dielectric properties.

This combination of properties makes it possible for the rubber fabricator to buy one compound which meets the Aeronautical Materials Specifications (AMS), joint military rubber (Mil-R) and ASTM specifications in the appropriate hardness. The K-1040's also have civilian uses, e.g., in home appliances. — **Silicones Div., Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.** 146C



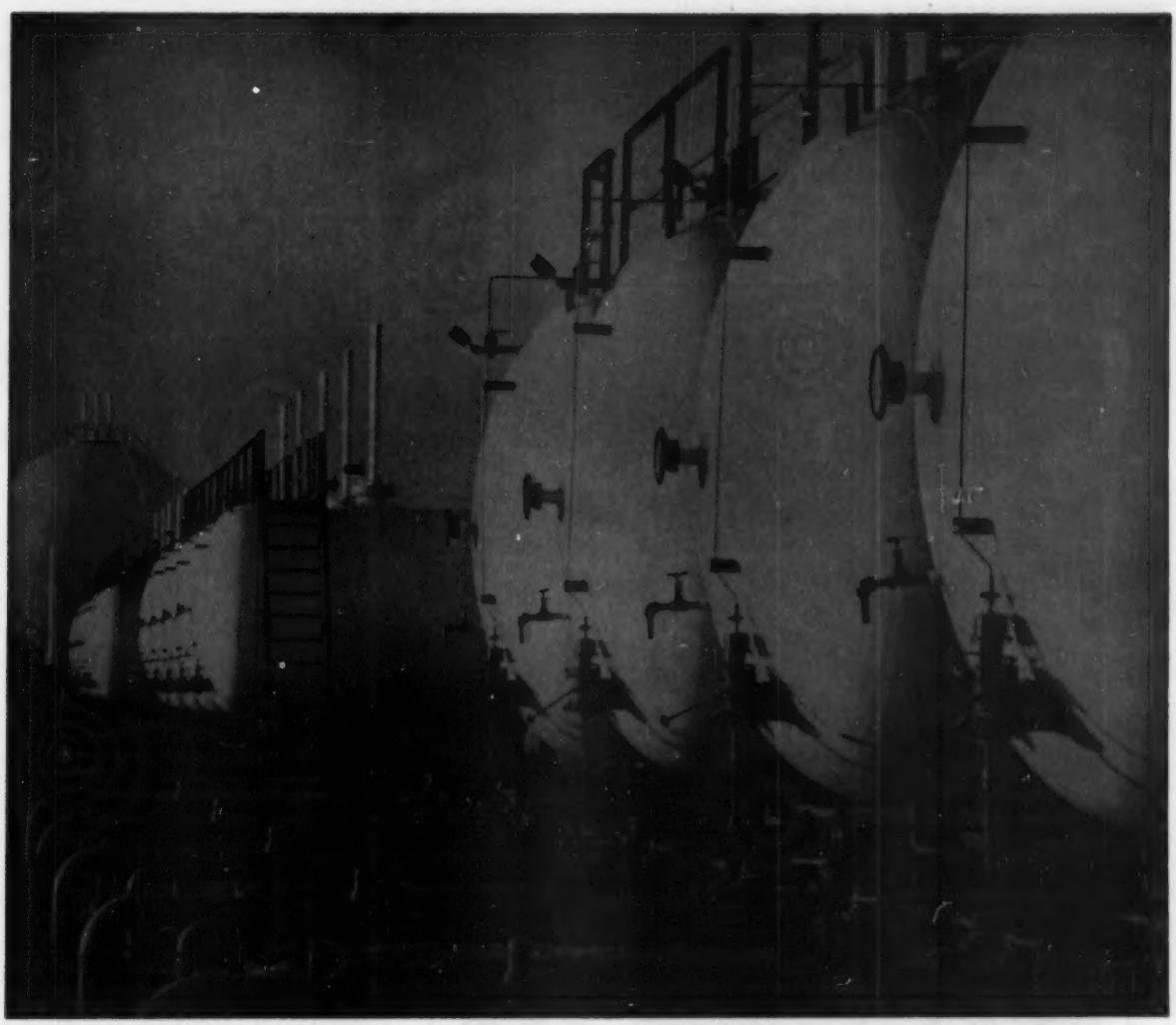
Polyester Film

New variation is heat sealable on both sides, can be combined into tubes.

Minnesota Mining and Manufacturing isn't wasting any time in establishing a firm foothold in the packaging field with its new plastic film.

Following close on the heels of its first announcement of Scotchpak "A," a polyester-based film, comes word that 3M is now prepared to supply a new variation, Scotchpak "B."

The new clear film ("B") is,



A small part of the huge hydrocarbon storage tank farm above and below ground at Petro. Propane is stored in the cylindrical tanks, butane and natural gasoline in the bubble-shaped Hortonspheres. Additional propane is stored in man-made caverns 330 feet down.

Petrochemicals . . .

from pipeline gases

At the Petro plant—Tuscola, Illinois—an endless stream of natural gas is being separated into ethane, propane, butane and natural gasoline.

products you need

The ethane is converted into ethylene, which is in turn converted to ethyl chloride, ethyl alcohol, ether and polyethylene. U.S.I. ammonia and sulfuric acid plants next door supply and receive raw materials.

for the future

Petro can manufacture products other than these if the demand arises—products that can be made from the many raw materials available at the plant site.

in bulk quantity

Why not add this plant to your facilities? Our engineers will be glad to discuss your long-term bulk requirements for chemicals from National Petrochemicals Corporation.

NATIONAL PETRO-CHEMICALS

CORPORATION

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company

99 PARK AVENUE, NEW YORK 16, N. Y.

like its predecessor ("A"), durable, non-toxic, chemically inert, impervious to odors, resistant to insect penetration. And it has the added advantage of being heat sealable on both sides (instead of just one), thus can be combined into tubes.

Properties of 1½ mil gage Scotchpak "A" and "B" (basically the same in chemical composition) demonstrate the performance capabilities of the film:

- Tensile strength—8,700 psi.
- Elongation at break—270%.
- Burst strength Mullen—25 psi.
- Temperature stability—from −60 F. to 240 F.
- Water vapor permeability—.4 g./100 sq. in./24 hr.

In addition, the film has high dielectric strength and dimensional stability.

Scotchpak "B" is currently available in 2½ mil gage only. Scotchpak "A," formerly available in 4½ mil thickness, is now being offered in gages of 1½ and 2½ mil.—**Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.** 146D

Workers Cite Benefits With Silicone-Treated Shoes

Workers who slosh through water, acid and alkaline solutions on their jobs are enthusiastic about Sylflex, the new silicone for leather. In work shoes, they say, it gives them greater safety, saves money.

Safety: Sylflex treatment imparts lasting water repellency without clogging the pores through which leather "breathes." Thus, a man wearing shoes made of Sylflex-treated leather can walk through water and acid solutions without getting his feet wet.

Economy: Water steals the life of leather. But Sylflex blocks water so that leather remains flexible; shoes don't stiffen, crack or curl after wetting. They last longer.

About 25 major shoe manufacturers are using Sylflex-processed leather this fall. They, together with Dow Corning and retail stores, are presenting a nation-wide program to introduce the public to the advantages of this silicone leather treatment.—Dow Corning Corp., Midland, Mich. 148A

Ultra-Pure Silicon

Essentially free of boron, can be used for semiconductor devices.

A new method devised to remove boron impurities from commercially available silicon is destined to open the door to improved transistors and other semiconductor devices.

Developed by Bell Telephone Laboratories, the process involves the reaction of molten silicon with water vapor to oxidize the boron. Oxidation products are evaporated.

To carry out the reaction, a liquid silicon zone supported only by surface tension is made to traverse a vertical silicon rod around which flows a mixture of hydrogen and water vapor. This technique prevents contamination from crucibles and provides a large interface between the silicon and the atmosphere. Under these conditions boron removal is very effective, increasing both with time and water vapor concentration.

Used together with Bell Labs' zone refining technique, the new method makes possible the production of silicon containing

KEL-F® FLUOROCARBON PLASTIC

can control corrosion in standard equipment and parts . . . over extended thermal range

The outstanding thermal and chemical stability of KEL-F PLASTIC provides one of the most effective means of preventing corrosion and thermal breakdown in industrial equipment and products.

Available in the form of a readily moldable thermoplastic, KEL-F PLASTIC is giving practical answers to some of the most vexing processing and production problems encountered today. KEL-F PLASTIC is unique in its resistance to chemical attack, heat, cold and moisture.

Consider these every day situations where KEL-F PLASTIC can be used to set up safe and dependable barriers to corrosive liquids, fumes, excessive temperatures, pressures and stress:

MOLDED AND FABRICATED

- Piping
- Gaskets
- Ring seals
- Gauge crystals
- Tubing
- Valve diaphragms
- Pumps
- Flow meters

KEL-F PLASTIC is available in the form of molding powders for compression, injection, extrusion and other molding techniques. It can also be obtained in film, sheets, rods, tubing, and other extruded profiles from qualified molders and fabricators throughout the country. Names available on request from Kellogg.

Send for our newly published booklet covering the entire family of KEL-F fluorocarbon products—Plastics, Dispersions, Oils, Waxes, Greases, Elastomers, Printing Inks and Chemicals. For your copy, write to the address below.

® Registered trademark of The M. W. Kellogg Company for its fluorocarbon products.

GENERAL PROPERTIES OF KEL-F PLASTIC

CHEMICAL STABILITY	Unaffected by concentrated acids, alkalies, organic solvents, oxidants.
THERMAL STABILITY	Operates over a wide temperature range (−320°F. to +390°F.).
MOLDABILITY	Readily molded on standard compression, transfer, injection and extrusion equipment.
ZERO MOISTURE ABSORPTION	Surface is non-wetting, anti-adhesive.
DIELECTRIC STRENGTH	Extremely high resistivity (10^{18} ohm-cm.); high dielectric strength.

The M. W. Kellogg Company
Chemical Manufacturing Division, P. O. Box 469, Jersey City 3, N. J.
Subsidiary of Pullman Incorporated

boron concentrations of less than one part in ten billion and having a resistivity greater than 3,000 ohm-cm.—**Bell Telephone Laboratories, 463 West St., New York 14, N. Y.** 148B

Fire-Retardant Mastic

Insulates metal surfaces against 2,000-F. flame.

A new resinous compound that will insulate a metal surface against reaching 1,000 F. for 30 minutes while being subjected to a 2,000-F. flame has been developed by Insul-Mastic Corp. of America. This marks the first time that a fire-retardant coating has been able to withstand such an extreme test.

Known as Fire-Retardant Insulating Mastic No. 5501, the new compound is a heavy-bodied black mastic which can be sprayed or trowelled to a thickness of ¼ to ½ in. on metal, wood, fibreboard and other materials. It won't run, drip, drop off or contribute fuel to the flame.

Although primarily developed as a fire- and heat-retardant coating for metal vessels, equipment and structural supports, the mastic offers unlimited applications wherever high temperature could conceivably be encountered.

Aside from its outstand fire-retardant properties, No. 5501 serves as an interior or exterior coating to insulate, reduce condensation, rustproof and waterproof in the range of −20 F. to 250 F. It weathers well, withstands acid and alkali fumes and splash, won't support mildew.

Coverage, with conventional mastic spray equipment, is economical. Twenty gallons are required per 100 sq. ft., ¼-in. thick. —**Insul-Mastic Corp. of America, 7750 W. 61st Pl., Summit, Ill.** 150A

BRIEFS

95% pure neodymium oxide is being offered as a commercial grade of purified rare earth with potential applications in ceramics, cracking reforming catalysts, metals, glass, etc. —**Research Chemicals, Inc., Burbank, Calif.** 150B

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Benzoic-toluic, a mixture of 85% benzoic acid and 15% *m*-toluic acid, will be marketed by Oronite Chemical Co. as a modifier of alkyd resins to improve properties of paints, enamels and other surface coatings. Market price of the 100% monobasic acid mixture will be about 20¢/lb. — **Oronite Chemical Co., San Francisco, Calif.** 150C

Broad-range lubricant, Atlantic Multi-Purpose Lubricant, can be used not only in chassis lubrication, but also in lubrication of wheel bearings, water pumps, track rollers, grease type universal joints, ball and roller bearings. Purple-colored lube is water repellent, offers protection against rust, can be used in high-temperature operations.—**Atlantic Refining Co., Philadelphia, Pa.** 150D

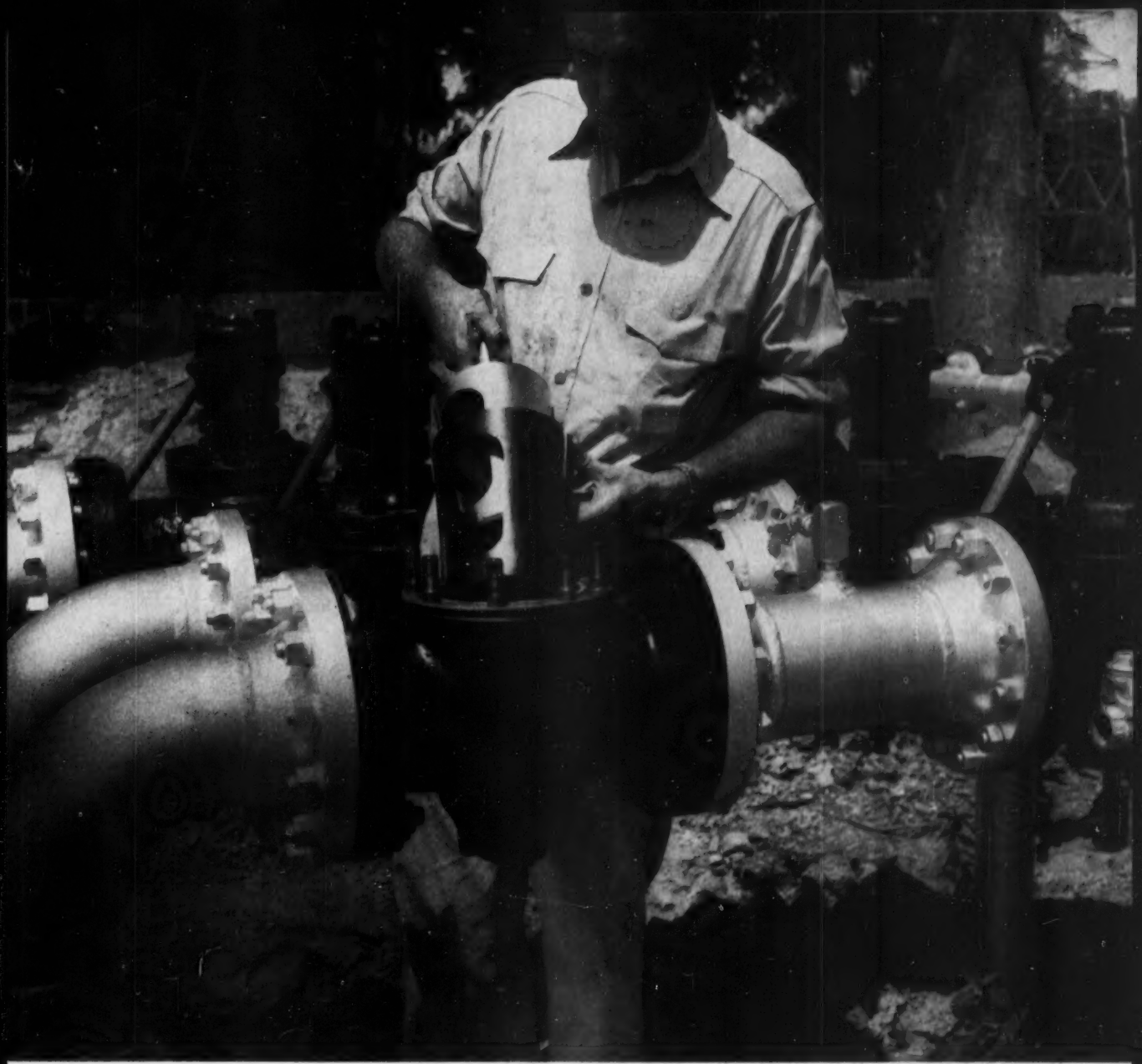
Whitening agent, Calcoflour White 4BT, previously used only on cellulosic fibers has been found to be most effective for acrilan. It requires no extra application step after bleaching, but can be applied either to the H_2SO_4 pretreatment or to the Textone bleach bath. Light fastness of 4BT is superior to most optical bleaches currently recommended for acrilan.—**American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.** 150E

Plant growth regulator, gibberellic acid, is said to have "exciting possibilities" as a plant growth stimulant. Experiments have shown it to speed growth of various field crops, grasses, tobacco, vegetables and flowers. Other potential uses: breaks dormancy in specific plants, stimulates germination in certain seeds, reverses dwarfism. Though as yet unavailable, even in research requirements, a small quantity of the acid is being distributed to agricultural scientists to obtain more information on its properties. —**Eli Lilly and Co., 740 S. Alabama St., Indianapolis, Ind.** 150F

New price schedule for basic urethane chemicals shows a reduction for Mobay's Mondur-S isocyanate from $1.23/lb. to 85¢/lb. in quantities of 10,500 lb. or more; Mondur-C isocyanate, from $1.12/lb. to $1.05/lb. for lots of 10,000 lb. or more; Multron R-2 polyester, from 85¢/lb. to 54¢/lb. for 5,000 lb. and over. Price cuts for smaller quantities of these materials have also been made. In addition to basic reduction of Mondur-C, 15% service reduction will be made to paint and adhesives manufacturers who formulate and market products incorporating this isocyanate. —**Mobay Chemical Co., 1700 S. Second St., St. Louis 4, Mo.** 150G

Synthetic resin films, called Nalfilm, now appear to have uses exceeding earlier expectations (as permselective ion exchange membranes). Available in two broad anionic and cationic classes, films are finding applications in deionizing water, radioactive waste disposal, salt-splitting reactions, uranium purification, etc. Ability to vary film strength, flexibility, electrolytic conductivity, moisture content, thickness suggests possible future use as static-free plastic and battery separators.—**National Aluminate Corp., 6216 W. 66th St., Chicago 38, Ill.** 150H

Tall oil monobasic fatty acids, under the tradename Pamak, are being offered as modifiers for resins and synthetic coating formulations.—**Hercules Powder Co., Wilmington 99, Del.** 150I



Cameron Sales Engineer, W. E. McDonald, demonstrates Hycar-coated seat.

DOUBLE LPG SEAL with Cameron Lift-Plug Valves

A renewable Hycar rubber-coated seat does the trick. The remarkable Cameron Non-Lubricated Lift-Plug Valve seals in both directions with smooth, sure, positive action. This super-tight seal keeps products in place—prevents trouble. One valve (with telltale needle valve in body) replaces two or more ordinary valves which only seal upstream or downstream.

Non-Lubricated means no contamination of line products, no fouling of delicate metering equipment — best of all non-lubricated means no maintenance. Simply set it and forget it.

The seat of the Cameron Non-Lubricated Lift-Plug Valve is separate from and not attached to the body. Body deflections do not affect mating surfaces of plug and seat. Friction is eliminated because the plug is lifted from the seat before rotating — actually never touches the seat except when completely open or closed. Plug and seat may be easily and inexpensively replaced without removing the valve from the line.

As in the case of these LPG Valves with Hycar coated seats, other special materials may be used for special services. If it's a difficult duty — acid, molten metal or the elusive LPG's, Cameron Lift-Plugs are already saving time and money for someone. It could be you.

Cameron

IRON WORKS, INC.

P. O. Box 1212-Houston, Texas

Export Office: 7012 Empire State Bldg., New York City. In England: Cameron Iron Works Ltd., Time & Life Bldg., New Bond Street, London W. 1 England.

Your Purification Problem may be tough

...is it this tough?

Get Pure Water from Sea Water
This Centrifix Purifier Does It

Design a separator unit to operate aboard an ocean-going freighter that would take sea water of any salinity and convert it to fresh water, thereby eliminating the tremendous fresh water storage capacity that is ordinarily necessary — this was the problem recently solved by Centrifix engineers.

The Centrifix Purifier, illustrated, was designed to accomplish this purpose and installed in the ship, T/T Saxonsky, where ordinary sea water was brought to a boil, changed to vapor and then condensed. In this process, the Centrifix Entrainment Separator of Monel removed almost every trace of salt. Actual records of an entire cruise show the high efficiency of the unit. A condensate was produced with a salinity of .1 grains per Imperial gallon — perfect for boiler use and entirely potable.

Whatever your purification problem . . . only Centrifix Purifiers will give you highest separating efficiency, broad pressure ranges, negligible pressure drop, self-cleaning, no moving parts and simple installation. Centrifix engineers will recommend specific equipment to meet your requirement . . . without obligation.

Write today for Centrifix Engineering Manual and Catalog

THE
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3608 PAYNE AVENUE
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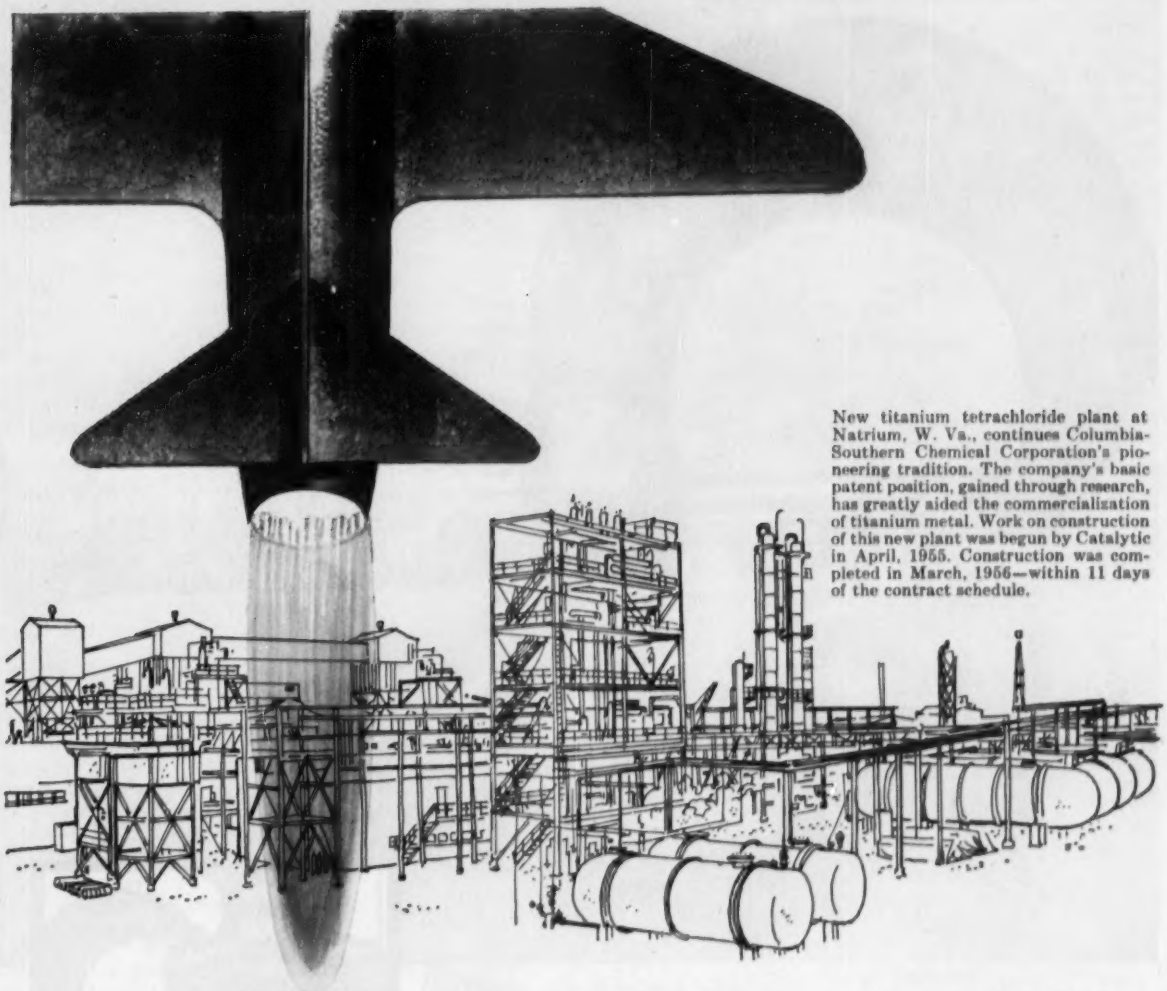


New titanium tetrachloride plant at Natrium, W. Va., continues Columbia-Southern Chemical Corporation's pioneering tradition. The company's basic patent position, gained through research, has greatly aided the commercialization of titanium metal. Work on construction of this new plant was begun by Catalytic in April, 1955. Construction was completed in March, 1956—within 11 days of the contract schedule.

$TiCl_4$
(Titanium tetrachloride)

A new multi-million dollar plant at Natrium, W. Va., is the answer of *Columbia-Southern Chemical Corporation* to the task of producing $TiCl_4$—titanium tetrachloride—which in turn is used in production of titanium.

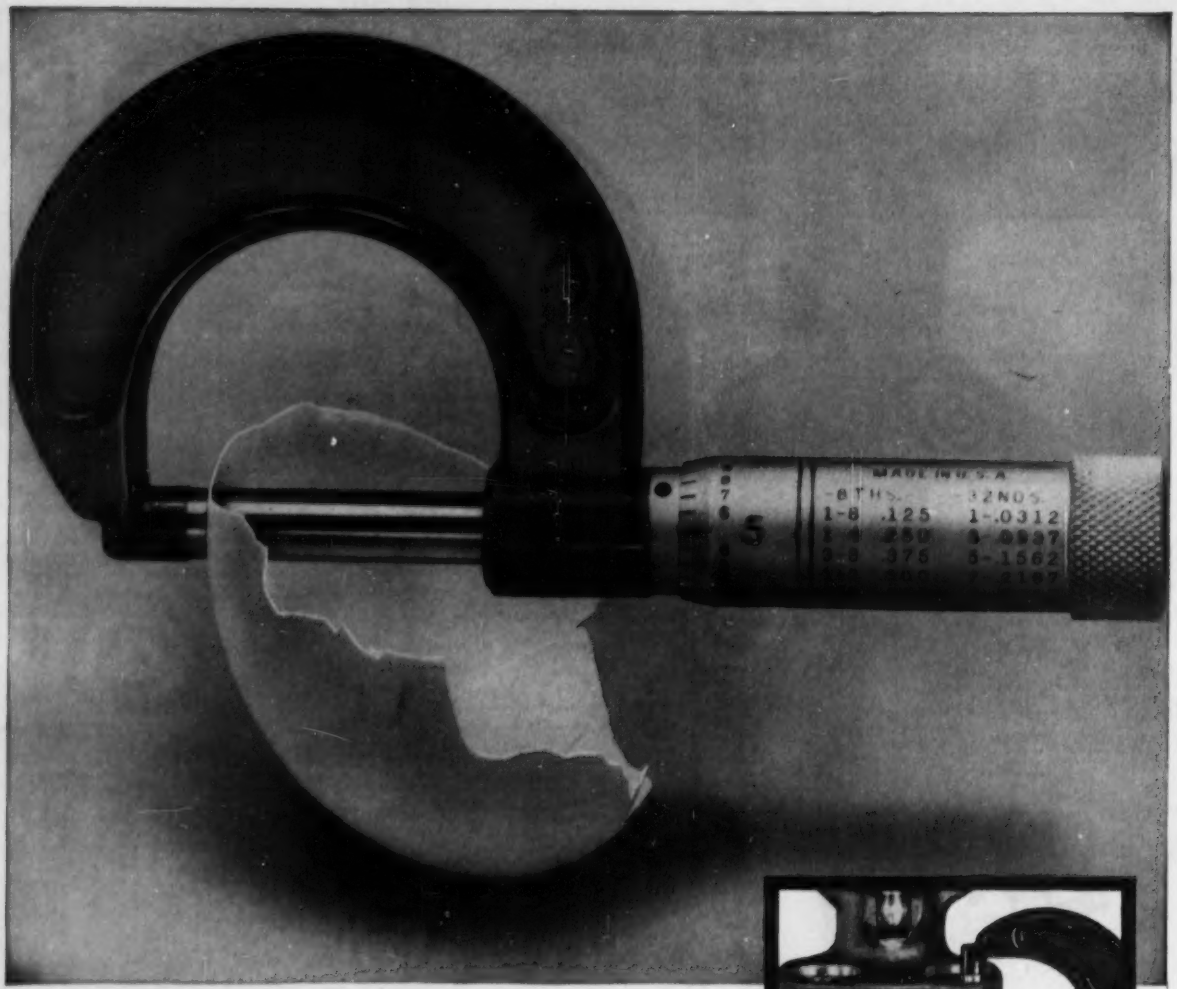
Titanium is metallurgy's answer to the need for metal resistant to high temperatures—as in supersonic aircraft.

Titanium tetrachloride—the product of this new plant engineered and constructed by Catalytic—has opened up important markets in diversified other fields as well as in production of titanium sponge. Its many uses include the manufacture of catalysts for plastics, the making of titanium esters, and service as a reducing agent for dyes.

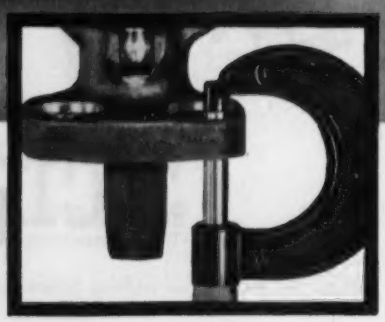
CATALYTIC
Construction Company

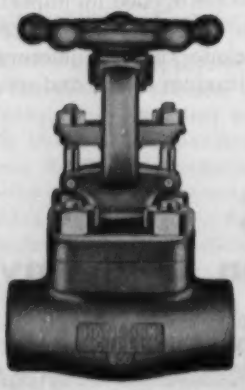
Philadelphia 2, Pennsylvania
Toledo, Ohio
In Canada: Catalytic Construction of Canada, Limited; Sarnia, Ontario; Toronto, Ontario; Montreal, Quebec

Catalytic *On-Time... On-Budget* Services
for the metallurgical, chemical, petrochemical and oil refining industries: Project Analysis; Process Development; Process Design; Economic Studies; Engineering; Procurement; Construction; Plant Operation



STRENGTH
that matches the purpose





THE BONNET FLANGES on the Type 950 Hancock Steel Gate Valve combine compactness with rugged strength *where strength is needed most.* Flange thickness and bolting provide sturdiness that can withstand more than ten times the rated pressure of the valve. Butting of the flange faces eliminates every possibility of bending and distortion.

In revalving old, or installing new process and power piping systems, the enduring strength of Type 950 Hancock Steel Gate Valves always proves there is no substitute for the economy of quality. Get complete facts. Phone your Industrial Supply Distributor today.

HANCOCK VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Watertown 72, Massachusetts

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

AN ADAMS *Report*

• Filtration the Answer to High Costs of Industrial and Process Water

Part 1

The continued expansion of our free economy is forcing management and design engineers to face the problem of *water*. Water is as essential to industrial development as it is to human life.

Municipal Supplies Limited

More and more we read stories in the daily papers of various cities which have had to apply restrictions on water consumption. While sprinkling bans may ruin your lawn this year, it is an omen of a possible water shortage in the future.

Natural Resources Restricted

The use of natural water resources . . . lakes and rivers . . . is being restricted by pollution. For example, the entire water of one of the major eastern rivers is reused seven times while moving one mile down stream. To make use of this water for industrial purposes involves an extensive treatment system . . . resulting in a high initial capital expenditure.

Water the Life Blood of Industry

This is not a patent cliche! It is a basic fact. Years ago water's primary importance to industry was as a means of transportation. Today water is essential to industrial survival. As with any commodity, as the supply decreases with respect to demand, the price per unit increases.

The cost of industrial and process water has risen rapidly during the past 10 years . . . will rise even further and more rapidly during the coming 10 years.

Methods of Solving Problem

More and more firms consider the problem of water shortage when planning the location of new plants. Plant sites are chosen near natural water resources. When the source is a river or lake, their planning often includes waste water disposal . . . a factor that did not exist some years ago.

River and lake water, particularly during rainy season run-offs, require water treatment of some sort. The higher the quality of the water needed by the plant, the more expensive the water treatment . . . but in the long run it pays for itself.

Filtration of the raw water with an Adams AWF Automatic Filter may eliminate the need for a pre-treatment settling basin. If water softening equipment is used, the AWF may also help reduce the cost of this equipment by the removal of solids from the water to be softened.

Filtration After Treatment

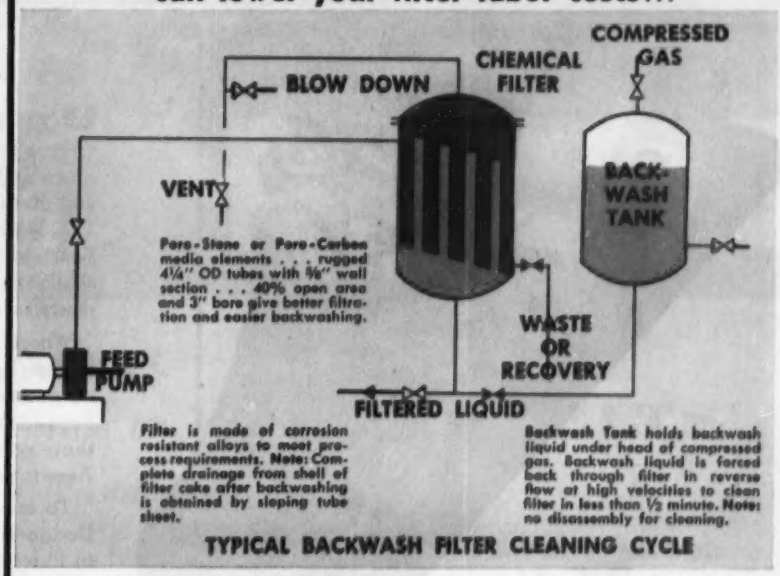
Where the polish of the industrial or process water is a critical factor, it very often pays to install a filter after the softening equipment. In this application the filter acts to remove the precipitated salts. These salts cause trouble by collecting in low spots, or reacting chemically when introduced into process solution. This phase of keeping your industrial water costs down will be covered in the next *Adams Report*. Watch for it.

New Bulletin Available

Bulletin 909, on the Adams AWF Automatic Filter is available upon request from the R. P. Adams Company, Inc., 507 East Park Drive, Buffalo 17, New York.

ADAMS BACKWASH DESIGN

can lower your filter labor costs...


COMPRESSED GAS
CHEMICAL FILTER
BLOW DOWN
VENT
BACK-WASH TANK
Pore-Stone or Pore-Carbon media elements . . . rugged 4¼" OD tubes with ⅝" wall section . . . 40% open area and 3" bore give better filtration and easier backwashing.
WASTE OR RECOVERY
FEED PUMP
FILTERED LIQUID
Filter is made of corrosion resistant alloys to meet process requirements. Note: Complete drainage from shell of filter cake after backwashing is obtained by sloping tube sheet.
Backwash Tank holds backwash liquid under head of compressed gas. Backwash liquid is forced back through filter in reverse flow at high velocities to clean filter in less than ½ minute. Note: no disassembly for cleaning.

TYPICAL BACKWASH FILTER CLEANING CYCLE

There are numerous filters which will meet the needs of your particular process. Your problem has become . . . "Which one shall I buy?"

Doubtlessly, there are other units which will produce as clear an effluent as the Adams filters. So the choice would seem to narrow down to initial investment. Here you will find Adams filters competitive in price.

What about operating and maintenance costs? That's where the Adams filter can save you money!

You clean your Adams filter by operating a few valves . . . no time consuming and often dangerous manual disassembly and cleaning necessary. Your filter is off-stream for as little as two minutes and seldom over 15. The liquid required for cleaning is only a small fraction of that needed by other filters using the reverse flow technique. And what's more, you get thorough cleaning. The Backwash liquid is easily recovered if necessary.

R. P. ADAMS CO., INC.
207 E. PARK DRIVE
BUFFALO 17, N. Y.

R. P. ADAMS COMPANY, INC. N-56
207 East Park Drive
Buffalo 17, N. Y.

Gentlemen:

We have a problem in chemical filtration. Please send us your Bulletin 431.

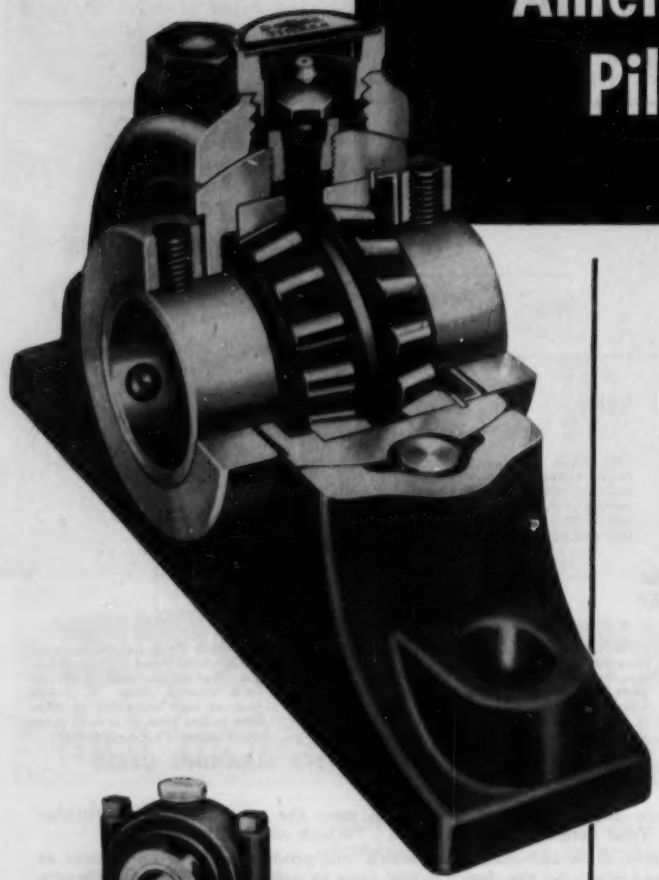
Name.....Title.....

Firm.....

City.....State.....

AVAILABLE IN FIVE TYPES
FOR ALL KINDS OF SERVICE

DODGE-TIMKEN
America's Quality Pillow Block



DODGE-TIMKEN Bearings are adjusted, lubricated and sealed at the factory. Labrynth seals effectively retain the lubricant and prevent the entrance of dust and dirt. The inbuilt precision of Dodge-Timken Bearings is protected both on and off the shaft. They are delivered fully assembled, ready to mount.

Where service conditions are toughest Dodge-Timken Bearings prove their quality decisively. For superior performance, dependability and long life they have won their reputation throughout industry as America's quality pillow blocks.

To meet varying service requirements Dodge-Timken Pillow Blocks are available in five types—the type E..Double Interlock (illustrated)..Type C..Special Duty ...and All-Steel. Available in a range of shaft sizes from 1-3/16" to 10".

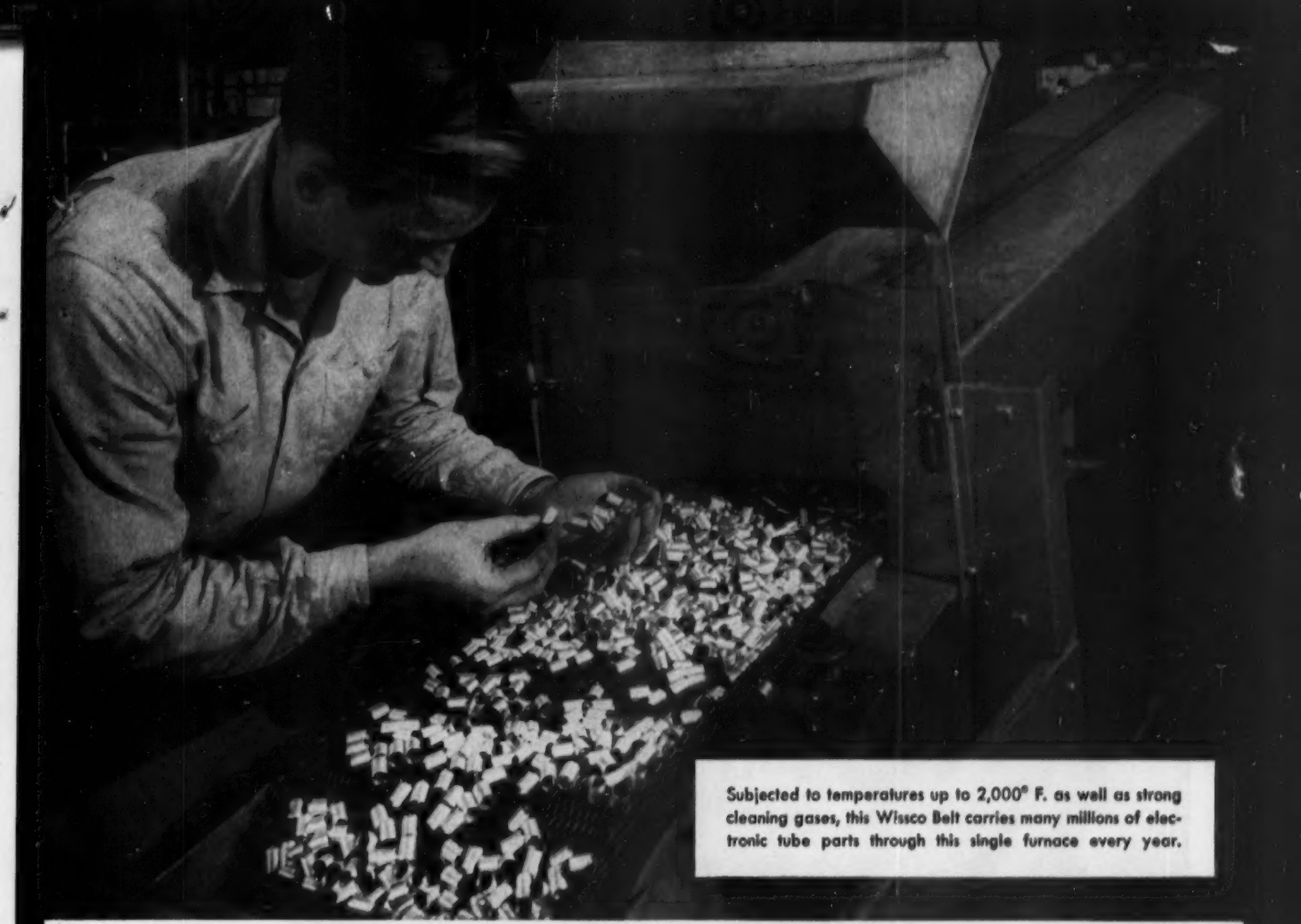
Call your Transmissioneer; or write for Bulletin A638 giving load ratings, dimensions and other data on Dodge-Timken Roller Bearings.

DODGE MANUFACTURING CORPORATION
200 Union Street, Mishawaka, Indiana

- COMPLETELY ASSEMBLED
- FACTORY ADJUSTED
- PRE-LUBRICATED

Call the Transmissioneer, your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

DODGE
of Mishawaka, Ind.



Subjected to temperatures up to 2,000° F. as well as strong cleaning gases, this Wissco Belt carries many millions of electronic tube parts through this single furnace every year.

FAMOUS NAMES
ride on WISSCO BELTS
Tung-Sol Electric, Inc. • Washington, N. J.

The story of Wissco Belts is best told by their users. For instance, Tung-Sol Electric reports:

"Our Wissco Belts performed without interruption for 4 years of continuous, 24-hour-a-day, 7-day-a-week operations . . . "

In spite of high temperatures and strong gases, that's the record of two Wissco Belts operated by one of America's well-known electronic parts manufacturers.

What's more, these two belts enabled Tung-Sol to increase production by 100% while reducing furnace feeder crews by 50%. "In a strictly cost accounting sense, the belts paid for themselves within a matter of weeks," according to the company's production control chief, Mr. Allen Mayberry. Yet the reliability of the belts is even more important, he points out, because millions of component parts used by the company each year must pass over one of these belts. "The Wissco Belts and the two electric furnaces in which they operate are so essential to our operation that our volume production quotas are based upon their output."

If you have any kind of processing or conveying operation, Wissco Belts can help you, too. Get the complete story today from the nearest sales office listed below.

THE COLORADO FUEL AND IRON CORPORATION
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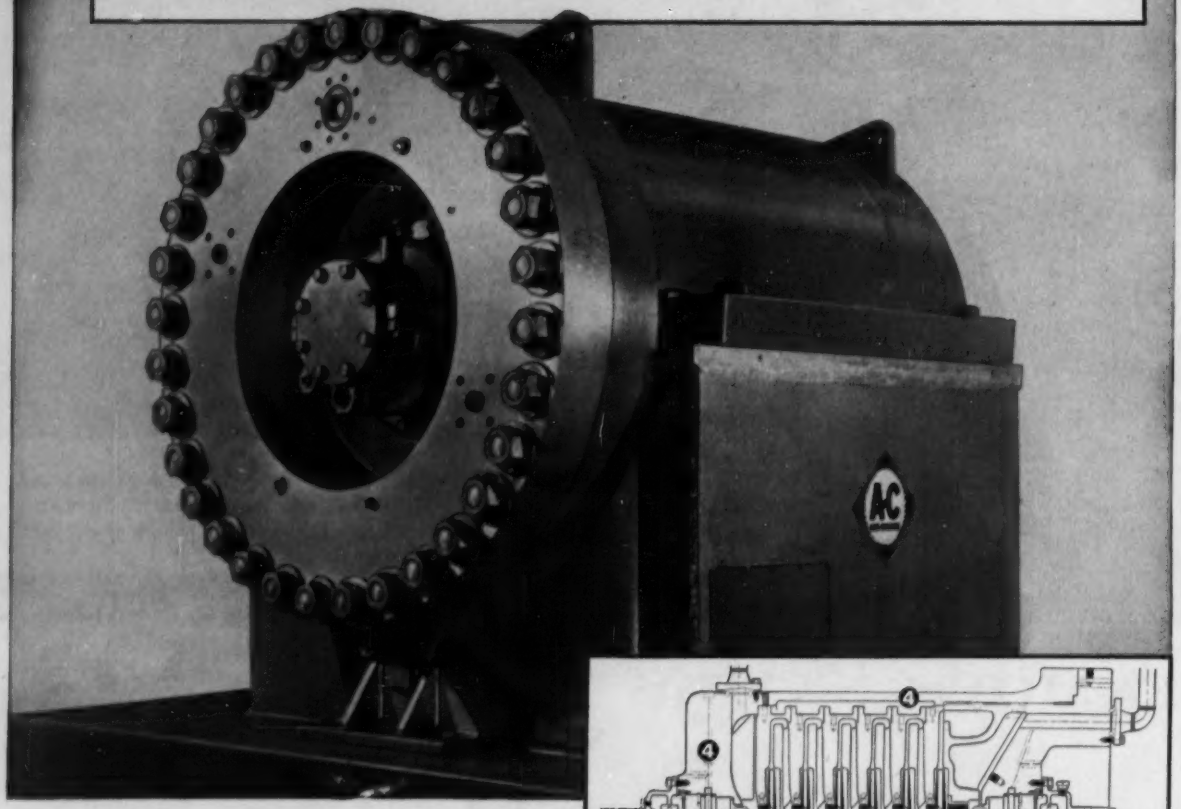
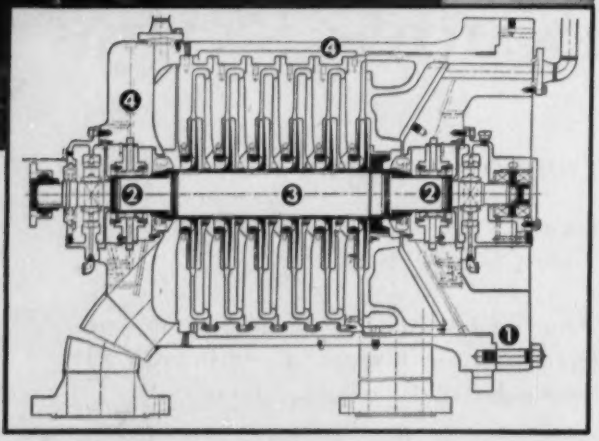
4371

ALLIS-CHALMERS
High Pressure
Barrel-Type
COMPRESSORS

for Non-Stop Service





'Round-the-Calendar Operation is built into the complete line of Allis-Chalmers high pressure barrel-type units for reforming processes. Here are four reasons for their dependability:

1. Simple to Maintain — Only one head bolted. Spiral-wound metallic gasket provides positive seal of casing joint.

2. Shaft Sealing — Double bushing seals have separate high pressure oil system. Inward seal leakage minimized.

3. Rugged Rotor — Impellers shrunk and keyed to shaft. Riveted impellers have rivets milled integrally from blade edge.

4. Extra Strong — Vertically split forged steel casings give maximum safety at high pressures.

Find out more by contacting your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

LIVE BETTER ELECTRICALLY

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5107

Spotlight on a good mixer...

ALCOA HYDRATED ALUMINAS SERIES C-700

This electron microscope photograph of Hydrated Alumina C-730 (magnification 25,000X) shows fineness of particles. Average number diameter is 0.06.

Fine particle size, uniformity, good mixing characteristics and substantial chemical neutrality make ALCOA Hydrated Aluminas Series C-700 outstanding general-purpose pigments. As fillers, coatings, reinforcing pigments and even mild abrasives, they improve the quality of such varied products as natural and synthetic rubbers, plastics, fine coated papers, cosmetics, paints and varnishes, adhesive tapes, cleaners and polishers.

Used as reinforcing pigments in natural and synthetic rubber, Hydrated Aluminas Series C-700 impart high tensile strength, tear resistance and modulus along with good resiliency. They mix easily and rapidly with rubber compounds—with relatively little sticking to the mixing equipment. Their dispersion is excellent.

As a paper coating pigment, Hydrated Alumina C-730 gives a coating of great brightness, opacity and gloss with a high degree of whiteness. Ink receptivity is high for the degree of gloss obtainable.

Equally desirable physical characteristics are obtained when Hydrated Aluminas Series C-700 are used as a filler in plastics, particularly vinyls . . . as pigments in casein paints . . . as a relatively soft, extremely fine abrasive in special polishing applications . . . or as a very fine, soft filler or base for cosmetic powders.

If *you* have need of an outstanding general-purpose pigment for *your* products, it will pay you to investigate ALCOA Hydrated Aluminas Series C-700. You'll find their contributions to better products often cost less than pigments you now use. Get complete information by writing ALUMINUM COMPANY OF AMERICA, 705-L Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA CHEMICALS
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Hagan Ring Balance Meter integrates data used to compute charges for air conditioning of Gateway Plaza Restaurant at Gateway Center, Pittsburgh

HERE IS A FLOW METER THAT CAN COMPUTE COSTS

Yes, and then some. The Hagan Ring Balance Meter can do the work of a meter, recorder, computer and controller—simultaneously! Basically, it's a simple mechanical device that measures the flow of any gas or liquid, but its applications in industry are almost limitless.

- *For a central air-conditioning plant,* it measures the exact amount of cooling supplied to each customer, at the same time computes how much each is to be billed.
- *For utilities and their customers,* the Hagan Ring Balance Meter measures the volume of flowing gases or steam or water. It makes accounting easier for both supplier and user, because it measures and records accurately. Its records can be used directly for billing.
- *In a large chemical plant,* it measures varying amounts of both water and alcohol in a flowing, mixed solution, and records the quantity of pure alcohol.

The Hagan Ring Balance Meter is so versatile that it can record up to four measurements simultaneously; measure specific gravity or density; automatically correct for temperature or pressure changes; integrate multiple flow data; and activate controls automatically.

This rugged yet sensitive instrument is typical of the advanced aids to industry which Hagan provides . . . in such varied fields as combustion and process control, force measurement, and industrial water conditioning.

Write for detailed information on Hagan Ring Balance Meters, included in our brochure of products and services. Ask for Bulletin GSP-901.

HAGAN CORPORATION
CHEMICALS AND CONTROLS
Hagan Building, Pittsburgh 30, Pennsylvania
Subsidiaries: Calgon, Inc. • Hall Laboratories, Inc.

NEW MULTI-Pak AIR FILTER OFFERS YOU A MEDIA CHOICE, FOR THE EFFICIENCY YOU WANT!

MORE THAN 50 SQ. FT. OF MEDIA IN ONE UNIT. Renewable media is shown here being placed on one of the seven metal inserts that fit into the "pockets" of the MULTI-Pak unit. One 2′ x 2′ x 22¾″ unit contains more than 50 sq. ft. of media.

PERMANENT FRAMES MAKE MEDIA SERVICING SIMPLE, INEXPENSIVE. Here is a loaded insert being placed into a MULTI-Pak "pocket". The insert snaps into place behind retainer and forms a positive seal against air leakage. Permanent frames insure easy, inexpensive servicing.

A new high in filter versatility!

HERE'S the latest from AAF—multiple-media MULTI-Pak, the most *versatile* mechanical filter made. This new AAF product was specially designed to offer higher air cleaning efficiency, higher dust-holding capacity in a mechanical filter.

The dry-type MULTI-Pak takes a wide variety of renewable media materials, offers a wide range of efficiencies—all the way from plant pollen to tobacco smoke—even on extremely high-temperature jobs! There are more than 50 square feet of media in the seven "pockets" of one 2′ x 2′ x 22¾″ unit— *thirteen times* more media area than face area. Permanent media frames insure a perfect seal . . . make media servicing simple and inexpensive.

Get all the facts on this newest "first" from AAF. For complete MULTI-Pak information, call your nearest AAF representative or write direct for Bulletin No. 237.

AAF Dust Control Equipment

Illinois Heating Specialties

AAF American Air Filter COMPANY, INC.

326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS

AAF Filters and Precipitators

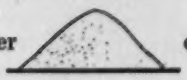
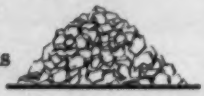
Herman Nelson Industrial Heaters

Product purification has many magnetic answers

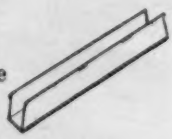
You want a clean pure product free from dangerous

tramp iron You need a magnetic separator to remove this iron contamination.

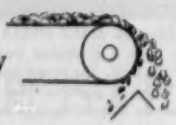
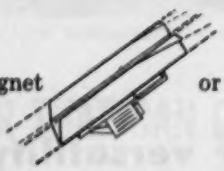
But what kind of magnet? First you contact a Stearns Magnetic engineer

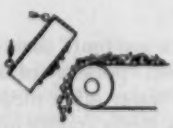
He checks your product; granular or powder  chunks 

liquid ; the kind of tramp iron, such as mixed scrap or tiny iron

particles ; the kind of conveyor like belt chute 

or pipe Based on these and many other factors, he might recommend a

magnetic pulley  or a spout magnet  or a magnetic drum

or suspended magnet  or multiple stage cross belt ;

or if the product is liquid, a magnetic filter or a pipe trap magnet

Stearns Magnetic, Inc. builds all these plus other highly specialized magnetic separators, electro or permanent, either in standard models or custom-built to your exact needs. We will be happy to send you literature on any of the separators mentioned above — or answer specific questions on tramp iron removal or product purification. Complete laboratory facilities available for testing materials. Write, wire or call us or see your Stearns Representative.

1127

STEARNS MAGNETIC PRODUCTS

A DIVISION OF THE INDIANA STEEL PRODUCTS COMPANY • VALPARAISO, INDIANA

629 South 28th Street • Milwaukee 46, Wisconsin

IT'S

stainless

FOR FILTRATION
OF CORROSIVES

Write for your free copy of Crucible's interesting and informative 44-page booklet, "Making the Most of Stainless Steels in the Chemical Processing Industries."

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

use steam efficiently, economically—choose the trap with . . .

top quality...

to keep it on the job

No need for a steam trap to be complicated. All it does is discharge condensate and air from steam lines and equipment. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

A steam trap has to be built to serve long and dependably in severe service—and that's where Nicholson quality counts heavily in terms of performance.

- **One moving part**
- **Positive shutoff—no steam waste**
- **Powerful, intermittent valve action**
- **High capacity—effective use of large orifice**

Specify Nicholson, and be sure.

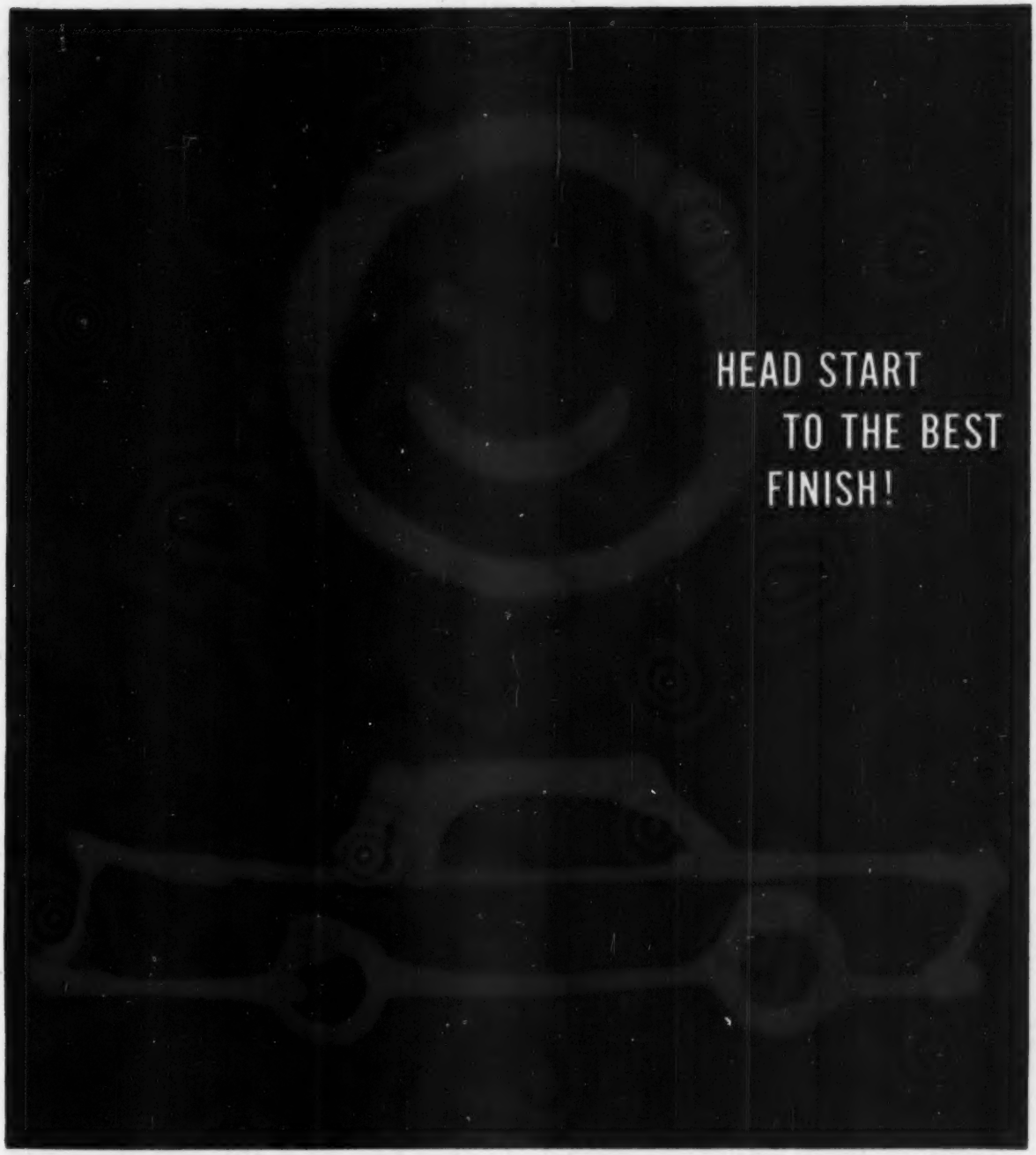
Write for new Bulletin 10-55

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES



Solvesso 150 has long been a standard solvent in baking-alkyd surface coatings used in the automotive industry. Unsurpassed in uniformity and purity, it is an outstanding member of the high-quality Esso family of aromatic solvents, the solvents that set performance standards *throughout* the paint and surface coatings industry. Esso's excellent customer service combines with the most modern handling methods and key distribution centers to assure you of a constant supply and *immediate* delivery. For a head start to the best finish, always specify Esso Petroleum Solvents. Write, wire or phone today! Esso Standard Oil Company, 15 West 51st St., N. Y. 19, N. Y.

SOLVESSO 150

SOLVESSO TOLUOL • SOLVESSO XYLOL • SOLVESSO 100 • SOLVESSO 150

High-Quality Aromatic Solvents covering the full range of industrial needs

Esso

PETROLEUM SOLVENTS

STANDARD GEARING

that meets SPECIAL needs available from STOCK!

Foote Bros. has pre-engineered an extremely broad range of gears to form an almost complete variety of ratios, capacities, center-distances and sizes to meet specific requirements. Manufactured to strictest quality standards, you'll find Foote Bros. open gearing the solution to availability and cost problems. See Foote Bros. for all your gearing needs. And they're completely cataloged . . .

FOOTE BROS. Duti-Rated Lifetime Gearing

Here's greater capacity in less space! Longer life Duti-Rated gears are specially heat-treated for increased tooth surface hardness and produced to high precision tolerances . . . yet can be ordered from stock to meet special gearing specifications! Send for the Duti-Rated manual for complete information and technical data on the standardized styles and sizes available . . . ask for Manual DR-2.

This Trademark Stands for the finest Industrial Gearing made.

FOOTE BROS.

Better Power-Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION

4545 S. Western Blvd., Chicago 9, Ill.

FOOTE BROS. Worm Gear Sets

Standardization and Quantity production—by Foote Bros.—make this line of quality standard and special worm gear sets possible. These are the same worm gear sets used in Foote Bros. famous Hygrade Drives, now made available for special operating and service conditions. Write today for this complete catalog of ratings and dimensional data. Ask for Manual SW-1.

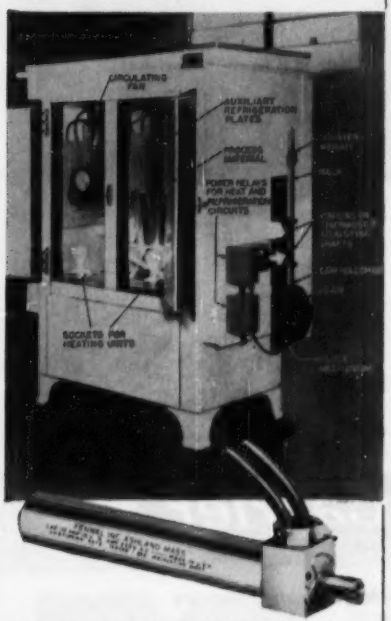
How to Build a Low Cost Program Controller

No. 8 of a Series — *Showing the broad application range of Fenwal Controls*

The problem was to develop an improved method for crystallizing fatty acids. Engineers at Fred S. Carver Inc., New Jersey, needed a means of changing temperatures automatically at various scheduled times during the process, which required temperatures ranging between 130 and 20°F with certain retention periods and closely controlled rate of change between each temperature.

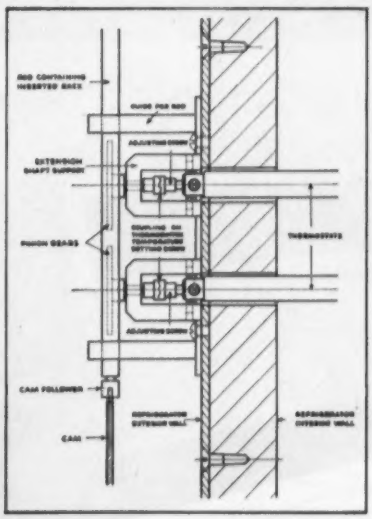
How Fenwal Helped Solve the Problem

The controller was built around two Fenwal THERMOSWITCH® units. One unit to control heating circuits, the other unit to control refrigeration circuits. The programming action is supplied by a rack-and-pinion arrangement. It resets the temperature setting screw of the control THERMOSWITCH unit as directed by an electrically-driven programming cam. The arrangement is used to control test runs to eight days' duration and produces a controlled rate of change of 1°F in four hours.



THE PROCESS CABINET shown here is a modified 18 cu. ft. refrigerator containing auxiliary cooling plates and heating elements. Each circuit is controlled by a cartridge-type THERMOSWITCH unit.

The adjusting screw of the THERMOSWITCH unit used in the process cabinet above is normally ½-in. long. In this application, however, the screw is extended to the outside of the refrigerator wall by a 3/16 in. diameter shaft coupled to the setting screw. A fine-toothed pinion gear (about 10 teeth per inch) is mounted on the end of each extension shaft. The teeth mesh with a rack inserted in a groove in the side of a ⅜-in.



diameter rod. The rod is guided vertically by two bearing blocks on the side of the cabinet. As the rod moves it rotates the pinion gears. This resets the control temperature of the process.

Key to Controlling Rate-of-Change

A cam mounted on the output shaft of an 8-day mechanism controls the position of the rack. The contour of the moving cam programs the process by holding the rack steady to maintain a constant temperature and by moving the rack at a given velocity to change the process temperature at a predetermined rate. *The key to controlling rate-of-change precisely is the fact that a given angular rotation of the adjusting screw of the THERMOSWITCH unit changes its control temperature by a constant, known amount (80°F per 360 angular degrees of rotation).*

Quick Recovery to Desired Control Temperature

Each Fenwal THERMOSWITCH unit controls its 110 volt AC circuit through a series-connected 25 amp relay. Either circuit can be made inoperative by disconnecting a male plug connected to the leads from the THERMOSWITCH unit. When both THERMOSWITCH units are connected, the heating and cooling systems are cycled alternatively to provide quicker recovery to the desired control temperature. The size of heat input is controlled by the capacity of the heating elements used in the heating circuit. To maintain a constant temperature or produce a low rate of rise 50- or 100-watt incandescent bulbs are used. For high rates of rise, some of the bulbs are replaced with 1200-watt resistance — coil heating elements. A circulating fan runs continuously to prevent temperature stratification and eliminate stagnant air that would slow up the response of the THERMOSWITCH units.

Proved Performance at One-Fourth the Cost

The estimated cost of the entire set-up was about $165 — about one-fourth the cost of an equivalent standard controller. And although used over a wide temperature range, there has been no trouble with condensation or moisture, because the electrical contacts of the Fenwal THERMOSWITCH units are sealed inside the cartridge.

Write for new Catalog No. 500 for details and complete product listings on Fenwal Thermoswitch Thermal Controls, including units discussed above, Midget and Miniature versions of these, Snap-Action Controls, and Indicator Controllers.

FENWAL INCORPORATED
1611 Pleasant Street
Ashland, Mass.

Please send me your Catalog No. 500.
Our specific problem is:.....
.....
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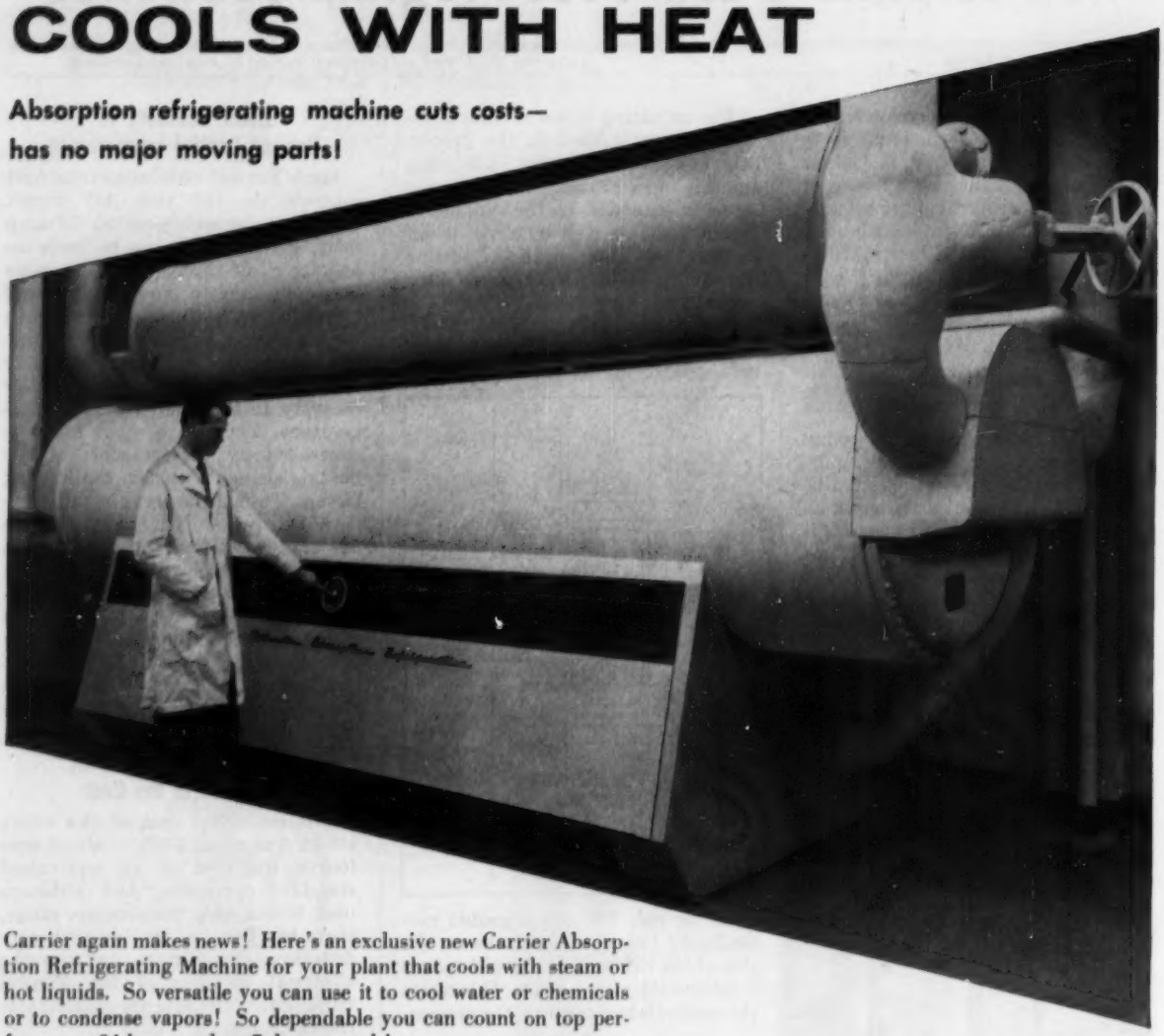
Name.....*Title*.....
Address.....
City.....*Zone*....*State*.....

Fenwal **CONTROLS TEMPERATURE . . . *PRECISELY***

Exclusive New Carrier Machine COOLS WITH HEAT

Absorption refrigerating machine cuts costs—has no major moving parts!



Carrier again makes news! Here's an exclusive new Carrier Absorption Refrigerating Machine for your plant that cools with steam or hot liquids. So versatile you can use it to cool water or chemicals or to condense vapors! So dependable you can count on top performance 24 hours a day, 7 days a week!

Low-cost cooling? You can get it with Carrier absorption refrigeration! Waste steam, hot water or chemical solutions are the energy source. Electricity is used only for small pumps and controls—there are no major moving parts!

Automatic operation? You can get it with Carrier absorption refrigeration! You push a single button to start the machine, push that same button again to stop it. No highly trained operator is needed. Electronic controls do all the "thinking."

A machine that follows cooling needs to *zero capacity*? You can get it with Carrier absorption refrigeration! It's the only refrigerating equipment that will operate in a completely automatic cycle from 100% full load down to zero capacity without expensive controls, and do it with a perfectly smooth operating curve.

And you get still other advantages from Carrier absorption refrigeration. Light weight. Compact design. Simple maintenance. A wide range of capacities—100 to 700 tons of cooling.

Get the full story. Call your nearest Carrier office for your copy of a new 36-page, illustrated booklet on Carrier Absorption Machines. Or write Carrier Corporation, Syracuse, New York.

Carrier

centrifugal compressors
refrigerating equipment

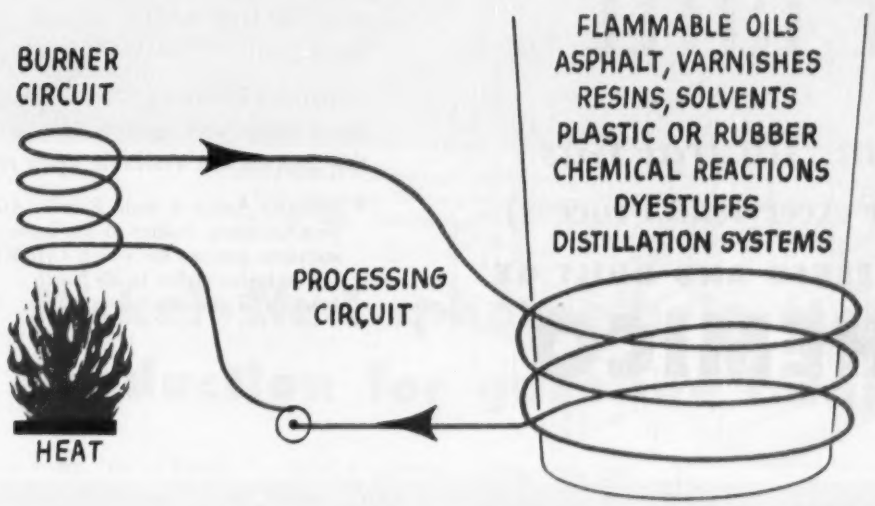
NOW... **NON-PRESSURIZED** LIQUID-PHASE HEAT TRANSFER SYSTEMS THAT OPERATE UP TO **600° F.**

AROCLOR 1248

✔ **Operates at atmospheric pressure** ... cuts installation and maintenance costs of expensive pressurized systems.

✔ **Fluid is fire resistant** ... increases safety by eliminating direct-firing and heat transfer with flammable fluids.

HERE'S PIN POINT CONTROL TO WITHIN 2° F.



The Equipment ... capacities can range from small portable units—usually electrically heated—to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Circuits are closed, forced-circulation. Compact design saves space, minimizes installation and maintenance costs.

The Fluid ... Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; is non-corrosive. Aroclor 1248 operates in most systems four to seven years without replacement.

Aroclor: Reg. U. S. Pat. Off.

Contact Monsanto for SOURCES of AROCLOR 1248 heating systems

MONSANTO

Where Creative Chemistry Works Wonders For You

MONSANTO CHEMICAL COMPANY, Organic Chemicals Division
Department IF-1, St. Louis 1, Missouri

Gentlemen:

Please send: ☐ Technical information about Aroclor 1248
☐ Names of designers and manufacturers of Aroclor 1248 operated equipment

Name .....
Firm ..... *Address* .....
City ..... *State* .....

World's Largest Acetylene Plant

from Natural Gas
(BASF Acetylene Process)

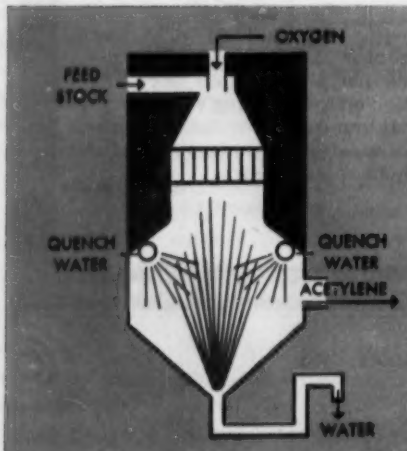
ENGINEERED AND BUILT BY
CHEMICO

The BASF* **Acetylene Plant** of American Cyanamid Company at Avondale, Louisiana, engineered and built by CHEMICO, is now being increased in capacity, making it the WORLD'S LARGEST ACETYLENE PLANT OF ITS TYPE.

By 1957, all the plants engineered and built by CHEMICO for the production of acetylene from natural gas will have a total capacity of 150,000,000 pounds per year.

Important features of the BASF process are listed below, and reprints of article describing this process are available upon request.

* Badische Anilin & Soda Fabrik, AG, West Germany, holder of the basic acetylene process for which CHEMICO has exclusive rights in all North American Countries.



Features of the BASF Acetylene Process

Produces commercially pure acetylene, meeting specifications for the manufacture of acetylene derivative products such as Acrylonitrile, Vinyl Chloride, Methylstyrene, etc.

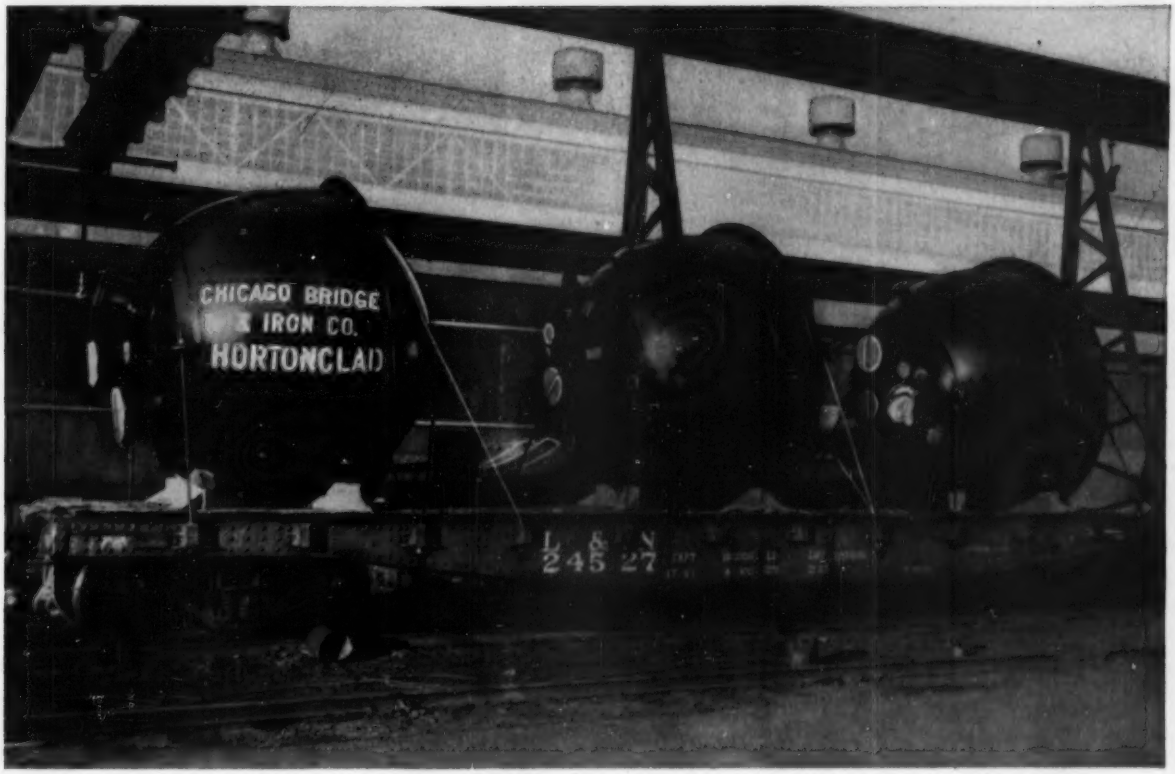
Permits the use of a variety of feed stocks such as Methane, Ethane, Propane and other petroleum gases.

Produces off-gas suitable for Ammonia and Methanol synthesis.

Permits integrated production of Acetylene and Ammonia to meet changing market demand.

CHEMICAL CONSTRUCTION CORPORATION
A SUBSIDIARY OF ELECTRIC BOND AND SHARE COMPANY
525 WEST 43RD STREET, NEW YORK 36, NEW YORK

CC319



Three Nickel HORTONCLAD spheres being shipped by their manufacturer, Chicago Bridge & Iron Company, Birmingham, Alabama. The spheres are used in processing PCl_3 to make tricresyl phosphate. ("Hortonclad" is a registered trademark of the Chicago Bridge & Iron Company.)

New Nickel-Clad spheres help step up PCl_3 production for gasoline additive

In the last three years, you've heard a lot about tricresyl phosphate.

Once used chiefly as a plasticizer for various resins, it has won fame in a new sphere. It is being added to gasoline to prevent build-up of carbon deposits in the engine.

PCl_3 in a new sphere, too

Tricresyl phosphate is made with phosphorus trichloride or one of the other chlorides of phosphorus.

To process PCl_3, a large chemical manufacturer has now installed the three nickel HORTONCLAD spheres shown above. By the Hortonclad method, solid nickel plates were integrally and continuously bonded to heavy steel backing by a special high-vacuum process, using a non-ferrous alloy intermediate layer.

Nickel protects *spheres* from corrosion ... assures long equipment life. Nickel protects PCl_3 from contamination by corrosion products. And tricresyl phosphate itself is frequently distilled in nickel equipment.

If you handle acid chlorides

... if you produce them ... ship them ... use them ... let Inco's Corrosion Engineering Section help you investigate Nickel and Monel* nickel-copper alloy. Data on *hundreds* of applications in acid chloride environments may help you avoid serious loss. Write today...let us know the nature of your problem.

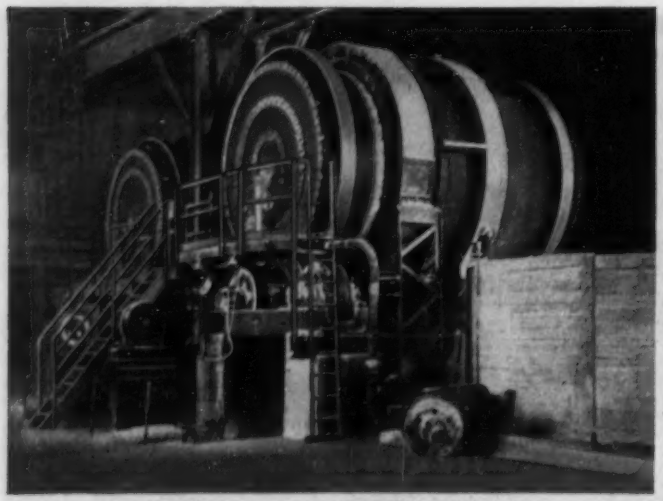
*Registered Trademark

Inorganic Acid Chlorides in which satisfactory use of Monel or Nickel is recorded

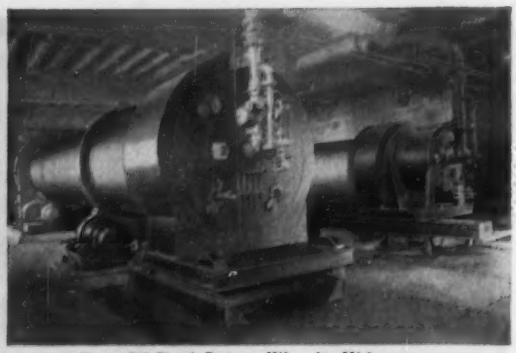
Corrosive Media	Monel	Nickel
Aluminum Chloride	Yes	.....
Ammonium Chloride	Yes	Yes
Antimony Chloride	Yes	.....
Arsenic Trichloride	Yes	Yes
Magnesium Chloride	Yes	Yes
Manganous Chloride	Yes	.....
Nitrosyl Chloride	Yes	Yes
Phosphorus Oxychloride	.....	Yes
Phosphorus Trichloride	.....	Yes
Silicon Tetrachloride	.....	Yes
Sulfur Monochloride	Yes	Yes
Sulfuryl Chloride	Yes	Yes
Tin Tetrachloride	Yes	Yes
Titanium Tetrachloride	Yes	.....
Zinc Chloride	Yes	Yes

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys**
... for product purity



Two Semi-Continuous Batch Rotary Kilns Pre-heating Electric Furnace Charges.



Two Oil-Fired Rotary Kilns in Midwestern Manufacturing Plant.

Rotary Waste Disposal Kiln Showing Skip Loader and Brick Ash Collection Chamber.

Batch AND Continuous Kilns

3 TYPES for a wide variety of pre-heating, processing and disposal operations

Bartlett-Snow batch kilns are ideally suited for pre-heating electric furnace charges. They bring the material up to temperature and remove moisture with a less expensive gas or liquid fuel, and shorten the furnace heating cycle, increasing its output.

Gas or oil-fired continuous kilns are designed for applying ceramic coatings to granules, calcining and nodulizing ores, and oxidizing and reducing operations at temperatures from 1000° F to 2200° F. Cylinder rotating speed can be varied to control the time the material is under treatment. Burners are controlled automatically with radiation pyrometers. Heated material can be cooled in separate equipment at gradually declining temperatures if desired.

Waste disposal kilns equipped with automatic equipment provide an efficient, smoke-free method of disposing of combustible liquids, sludges and other industrial waste materials.

Use our complete facilities, including materials handling, on your next job! It fixes unit responsibility; assures the smooth, synchronized operation of the entire project; and utmost economy and satisfaction!

DESIGNERS ENGINEERS

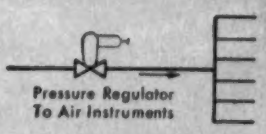
BARTLETT-SNOW
CLEVELAND 5, OHIO

FABRICATORS ERECTORS

DRYERS • COOLERS • CALCINERS • KILNS — *Complete Facilities Including Materials Handling*

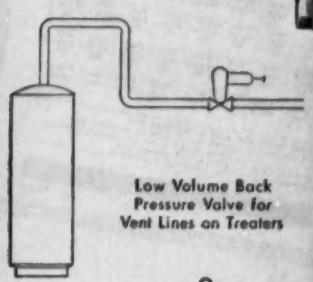
1st Choice FOR POUNDS TO POUNDS SERVICE

FISHER®

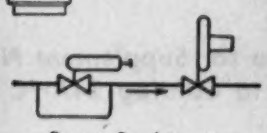


Pressure Regulator To Air Instruments

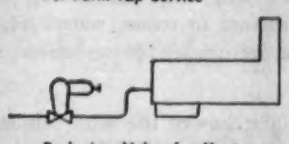
Pressure Regulator For High Pressure Gas Bulk Storage



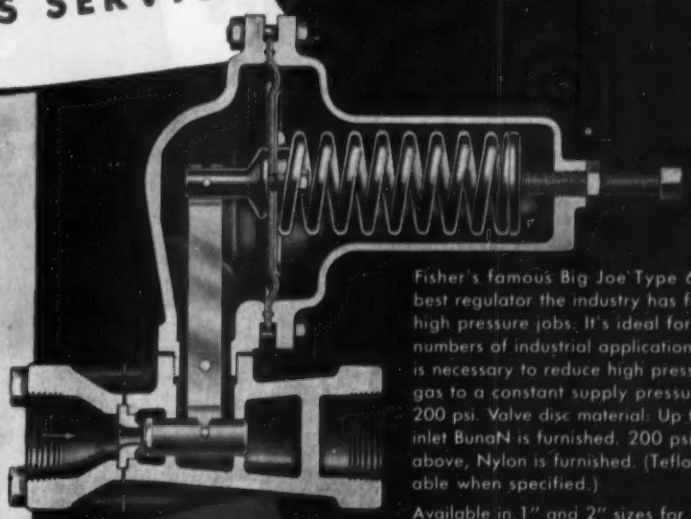
Low Volume Back Pressure Valve for Vent Lines on Treaters



Pressure Regulator For Farm Tap Service



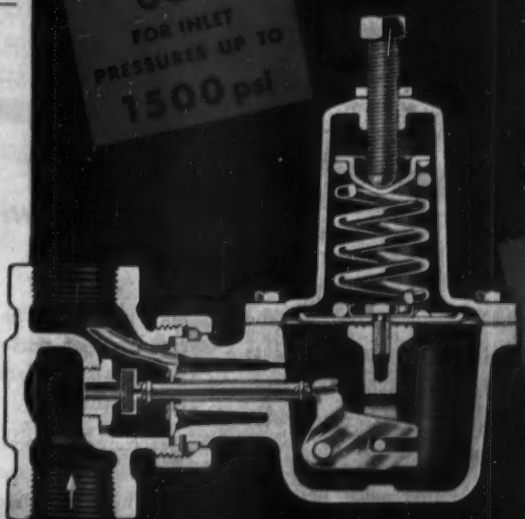
Reducing Valve for Heater Fuel or Treater Furnace Fuel



Fisher's famous Big Joe Type 630 is the best regulator the industry has for rugged high pressure jobs. It's ideal for countless numbers of industrial applications where it is necessary to reduce high pressure air or gas to a constant supply pressure of 5 to 200 psi. Valve disc material: Up to 200 psi inlet BunaN is furnished. 200 psi inlet and above, Nylon is furnished. (Teflon is available when specified.)

Available in 1" and 2" sizes for inlet pressures up to 1500 psi and outlet pressures 5 psi to 200 psi.

TYPE 630 FOR INLET PRESSURES UP TO 1500 psi



TYPE 620 FOR INLET PRESSURES UP TO 750 psi

For real economy the Fisher Type 620 pounds to pounds regulator is used on same applications as 630 "Big Joe" where pressure and flow requirements do not exceed 750 psi and reduced pressure not above 100 psi.

For inlet pressures up to 750 psi with malleable iron or cast steel body; up to 150 psi with cast iron body. Outlet pressure ranges: Type 620—3 to 60 lbs. (4 springs). Type 621—3 to 100 lbs. (5 springs). Valve disc material: BunaN when inlet pressure is 300 psi or less, and Nylon when inlet pressure exceeds 300 psi.

Sizes: ¾", 1" and 1¼" with cast iron or cast steel body. ¾" and 1" with malleable iron body.

FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA
WOODSTOCK, ONTARIO

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER Since 1880

See them Now!

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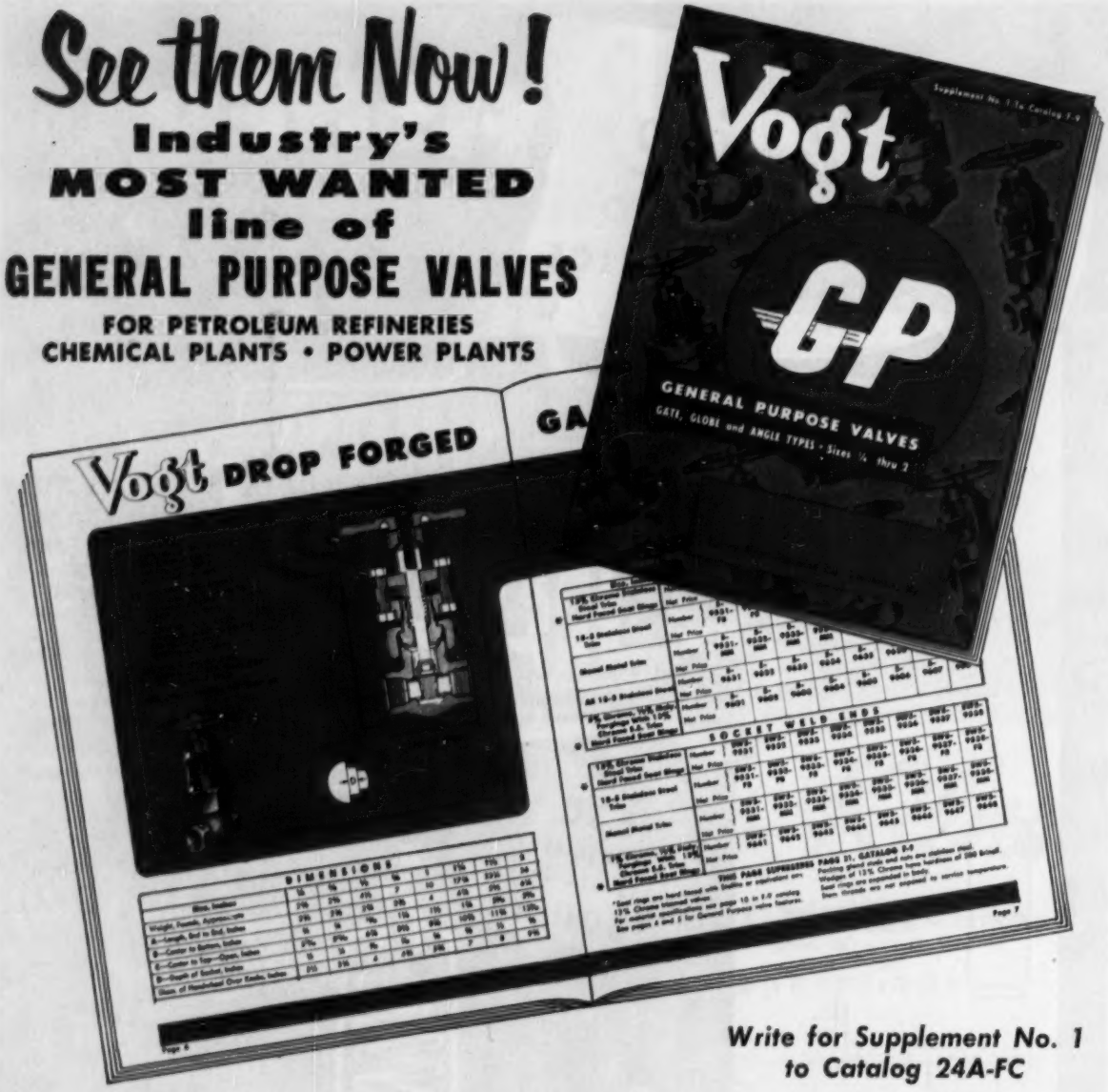

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Chemical Engineering
NOVEMBER 1956

17th Biennial Report on . . .

Materials of Construction

Part I—Protective Lining Systems

Economic life of process equipment depends on intelligent choice of lining used, and on its proper application. This report can help prevent costly errors. It is the first comprehensive guide to linings . . . . . p. 176

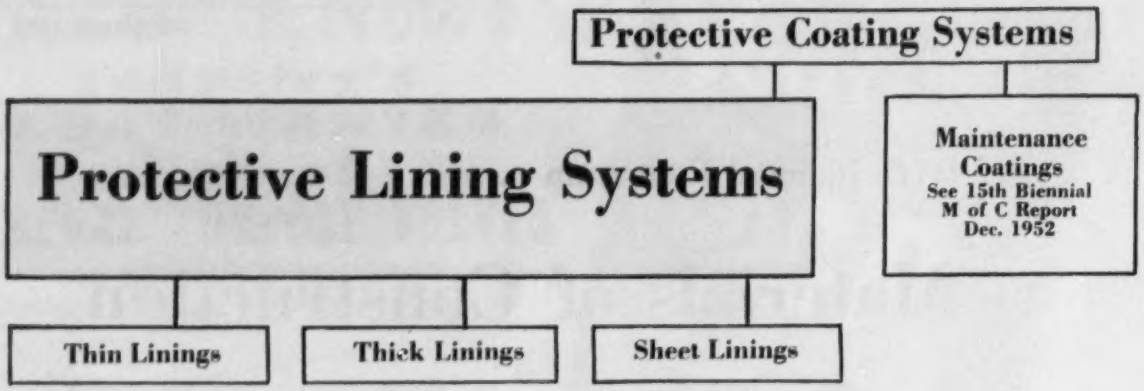
Richard A. Mixer (left), of the consulting firm of R. A. Mixer & Associates, Union, N. J., formerly managed Metalweld's protective coatings work.

S. John Oechsle, Jr. (right) is vice-president of Metalweld, Inc., Philadelphia, and is responsible for the company's Protective Coatings Division.

For more about Mr. Mixer and Mr. Oechsle see p. 408-9.

Part II—Directory of Construction Materials

In this directory you will find who makes materials for chemical plant construction—together with trade-names, forms available, and end-uses in chemical process equipment . . . . . p. 197



For more than 2,000 years, protective coating systems have been used to eliminate or reduce corrosion and to control contamination.

This report is concerned primarily with those coatings known as protective linings. It deals with the proper selection and application of linings to protect the interior of process, storage and transportation equipment—as contrasted with maintenance coatings.

Maintenance coatings can be defined as those coatings which are applied to the surface of basic construction materials to protect them from corrosion due to relatively unpredictable, external fume environments (such as air, water, water vapor, chemical fumes, chemical splash and spill).

Linings, on the other hand, are used specifically to protect materials of construction from corrosion where (1) the internal environment is relatively predictable, and (2) where the base material is subject to continual exposure to a corrosive chemical. In some cases, linings are not used to protect the base structure, but rather the chemical product itself—from contamination by slight corrosion reactions which would otherwise render the product worthless or sub-standard.

In both of these protective coating system divisions, the same basic materials are found. Organics (such as rubber, vinyls, mastics, chlorinated hydrocarbons, epoxies, fluorinated hydrocarbons, furanes) and metals (such as zinc, aluminum, lead, stainless steel) are formulated into protective systems for both maintenance coatings and process equipment linings.

When one of these materials is exposed to continual immersion, the action on it is usually much more severe than when it is subjected to splash and spill. Therefore, the formulation of a specific coating or lining depends on whether it is to be used as a maintenance coating or a process equipment lining.

Certain resins are more resistant to caustic attack and others to acid attack, but the degree of resistance depends largely on the formulation. The 15th Biennial Materials of Construction Report (*Chem. Eng.*, Dec. 1952) outlines a guide to the basic resins available and their chemical resistance.

In some cases, there is an overlapping of a particular application into either the maintenance coating field or the process lining field. Example: where the rubber lining of the interior of a plating tank is carried completely over the outside to provide the exterior with a protective coating against fumes and splash.

In contemplating a lining for protection of process equipment, chemical composition and concentration of the liquid are important factors. The chemical composition within a certain vessel is definite, or falls within specific limits, so that a fairly constant corrosive condition may be assured. Therefore, the selection of materials can be made from those offering the most resistance to the specific exposures that are expected.

Temperature is an important factor when dealing with process vessels as well as storage vessels. Generally, the maximum temperature is known. But in certain cases, local hot spots cause different effects on the inner barrier.

Abrasion is a third factor which must be considered when specifying a process equipment lining.

Why a Lining?

First question to be asked when selecting a lining is, "Why is the lining being considered or needed?" It is generally best at this point to decide whether the problem is:

1. Base material corrosion primarily.
2. Product contamination primarily.
3. A combination of 1 and 2.

In dealing with base material corrosion, the basic factors of the corrosion reaction and the corrosion rates on both the base material and the proposed lining are needed.

In dealing with product contamination, the basic factors of the contamination reaction and the detrimental nature and magnitude of this reaction are needed—as is the degree of contamination allowed. In modern competitive selling, contamination problems are becoming increasingly important. And every sales department knows the value of appearance, even where the product already complies with the minimum contamination allowable.

In the combination corrosion and contamination case, not only must the above factors be known, but if one lining cannot economically perform both jobs, an evaluation must be made of which effect is the more important to be combatted. In any case, the possibility of the lining itself contaminating the product should be checked.

When to Use a Lining

A complete knowledge of the economic factors involved is necessary

for a proper evaluation of when a lining is justified. Included are:

1. Considerations of the frequency of plant disruption at change-over time.
2. Effect on safety of personnel when handling dangerous chemicals.
3. Possibility of in-place repair of a lining that has suffered mechanical damage, and the effectiveness of such repair.
4. Price differential between contaminated and uncontaminated products.
5. At known corrosion rates, life of an unprotected tank.
6. Possibility that inhibitors can economically retard corrosion rates within acceptable limits.
7. Possibility that inhibitors or further processing can economically purify contaminated products.
8. General considerations of time, initial cost, average life cost and interruption cost.
9. Possibility that other base construction materials might have within themselves a sufficiently low corrosion rate as to be economically feasible.

To have a complete understanding of the problems involved in selecting a lining, an analysis of the particular conditions of corrosion in relation to chemical exposure, the type of vessel to be protected and the existing condition of the metal must be known.

The check-sheet (p. 178) shows the information that is necessary to make a comprehensive study of the situation. It should be filled out for each individual tank, pipe, vessel, etc., where corrosion is a problem.

Sometimes it is difficult to indicate the exact nature and concentration of solutions, and time cycles are sometimes indefinite. However, maximum and minimum figures in these cases should at least give an indication of the type of exposure which is prevalent.

Temperature portion of the check-sheet is very important, and it is most imperative that these items be entered as accurately as possible. Sometimes it is necessary to explain in more detail than is allowed on the check-sheet so that variations in process can be covered to their fullest degree. Abrasive action with a slurry or pulp may have a definite effect on selection.

Description of the vessel to be protected is also important. It gives an opportunity to get an idea of magnitude in reference to cost—as well as the practicality of performing the job in the relatively controlled environment of an applicator's plant, or performing it on the job site.

Often only a portion of a vessel needs to be protected, and this should be itemized in detail. It is possible that various protective linings can be used within the same vessel to accomplish the desired results: one being particularly resistant to fume attack, another being resistant to liquid content, and another to abrasion.

After the unit has been described, it is also important to know what specific chemical materials have been in contact with the base metal during former service, and the condition of the surface with respect to the type of pits. Extent and depth of the pits is important from the standpoint of proper surface preparation.

If coatings have been used previously, this information should be presented so that there is a complete history of the vessel. Historical data along these lines, of course, is often the best indication as to the selection of future linings.

What Type of Lining?

Assuming that it has been decided to use a lining to satisfy the corrosion or contamination problem, and the nature of the equipment to be lined is known, the next question to be asked is, "What should we look for in a specific protective lining to satisfy our problem?"

It would be impossible to indicate here all of the many systems which could do a job, as well as indicate specific recommendations using certain systems as solutions to particular problems. However, there are general guides which should be used for the selection of certain systems which fall within one of three groups: (1) thin linings (0.006-0.015 in.), (2) thick linings (>0.015 in.), and (3) sheet linings (>0.060 in.).

Porosity Is Basic to Selection

The basic principle in the selection of one of these groups can be developed on the basis of whether or not porosity of the inner lining is important.

When dealing with a clear-cut case of the control of product contamination as the only factor, thin linings can be used successfully. If by far the greater area of a piece of production equipment is covered, and only slight porosity (or a small break in the lining as a result of physical damage) exists, protection against contamination is usually sufficient with thin linings.

If, on the other hand, corrosion is the basic factor and porosity of any type or degree cannot be tolerated—or if a break in the coating as a result of physical damage or abrasion is unwanted—a sheet lining system should be specified.

As can be seen, there are many cases which are not clear-cut, where product contamination and control of corrosion are both important factors. The decision in these cases (as to the selection of the particular system of protection) then becomes more difficult. Economic considerations, expected service life, effect of failure, and basic cost of application are the deciding factors. It is assumed that the lining is compatible with the product.

If porosity cannot be tolerated, then any system which has a tendency toward porosity even in the slightest degree should be eliminated from the consideration—thereby eliminating thin coatings and some of the thick coatings.

Since this subject of porosity is so important in lining selection, it might be wise at this point to discuss what porosity means and the various factors to look for when considering specific systems and their relationship to porosity.

Nature of Porosity

Because of the inherent methods of application when coatings are sprayed, brushed or dipped either in liquid or semi-solid form, it is always well to assume that these coatings will be porous to a certain extent.

Multiple coats of organic paint have a tendency to reduce the porosity in a number of instances, and the probability of pinholes occuring over one another in succeeding coats is geometrically reduced as the number of coats increases. However, in many cases, it only takes one pinhole to cause failure. Once failure of the lining occurs, failure of the vessel because of corrosion results.

In the case of thin linings, even though they may be tested with low voltage spark testers to guard

Check-Sheet of Problems in Selecting a Lining

Service Conditions

Nature and Concentration of Solutions _____

_____

Continual Immersion _____ Time _____

Alternate Wet and Dry _____ Cycle _____

Vapor and Fumes _____ Time _____

Temperatures Encountered Max. _____ Min. _____ Avg. _____

Time of exposure at maximum temp. _____

Time of exposure at minimum temp. _____

Abrasion Action Involved _____

Other Conditions _____

_____

Unit Description

Description _____

_____

Industry _____

Size _____

Square Footage Coated _____ Interior or Exterior _____

Shop or Field _____ Indoor or Outdoor _____

Condition Unit Received

Former Service _____

_____

Type of Surface _____

Condition of Surface _____

Former Coating _____

Length of Time Since Last Coated _____

against the change of porosity prior to placing the vessel in service, there are possibilities that only one or two coats out of the possible six to ten are protecting the surface. Most organic coatings have a high dielectric strength. Therefore, as long as there is one coat between the spark testing probe and the base metal, no spark will pass, indicating that the coating is pinhole-free. Through changes in polymerization of the coating, aging, and the physical action during use of the vessel, the one or two-coat protection may not give the expected service life.

There appears to be a good probability that even though a thin coating tests pinhole-free, there will be a pinhole at some unknown point of weakness within a relatively short time. Therefore, use of thin linings (up to 0.015 in.) of an organic resin base offers risks when porous-free results are desired.

Pinholing is generally described as a small opening in the lining, usually occurring during application. Since the coating is applied without external pressure, and in most cases in liquid form, pinholes can occur for many reasons.

By careful formulation of the paint, the probability of forming pinholes during application can be reduced. Every coating system has certain application techniques to reduce the tendency of pinholes, but this does not mean that pinholes could not occur in local spots where the application is not properly controlled.

In the application of sprayed metal linings, porosity is inherent and cannot be eliminated. During application, the metal wire is liquefied, then atomized and sprayed on the base metal. During the atomization process, the small particles of the metal coating are in plastic state. As a result, their physical structure does not lend itself to complete flow-out. It might be imagined that a coating resembles a number of fish scales held together by oxide cementation, welding one fish scale to another at the interface of each, and the void between each one of these particles is porous.

Determination of Porosity

In the case of organic coatings, electrical methods of testing for pinholes have been employed, using low voltage (6 to 90 volts) and a

salt solution. This, of course, will show the obvious places were electrical contact can be made. But again, since only one coat is necessary to interrupt the electrical contact, these methods of testing are not infallible.

Then too, it has never been decisively determined whether a salt solution will actually penetrate the finest of pinholes. Some advances have been made in producing a spark tester using higher voltages in the range of 600 to 3,000 volts. This method, without the use of a salt solution, offers many advantages over the wet method.

First, the tester can be used during the application of materials which are subject to action by water, such as the phenolics. In addition, this method appears to stand a good chance of picking up weak points in the lining, as where only one coat is actually offering protection. It will spark on any pinhole, however thin the coating.

Pousson's Law indicates the minimum voltage necessary to pass a spark through a certain gap. It has been found that by slightly increasing this minimum voltage and making allowances for atmospheric pressure, and with sufficient power, a spark will jump from the testing machine to the base metal no matter what size the pinhole may be.

If spark testers with high voltage output are used on thin coatings, and if they exceed the dielectric strength of the film, they have a tendency to create pinholes by burning through the coating. Therefore, it is very important not to have voltages in the ranges of 15,000 to 30,000 volts on coatings under 0.015 in. These high-voltage testers are used when testing sheet linings greater than 0.060 in. Pinholes can be positively detected in any non-metallic lining.

If you can be sure that a particular thin lining is absolutely pinhole-free using a method which really divulges all pinholes and their location, then it is entirely conceivable that this particular system might offer an economical basis on which the desired protection could be obtained. Again, with thin linings, the risk involved through physical damage or abrasion and the possibility that chemical action may occur on the surface are significant—and this risk should be evaluated along with the economic study.

Suitability To Environment

Suitability of the lining to the corrosive environment is another good general guide in the selection of a lining system.

Determination is normally done with test samples similar to those used in analyzing maintenance paints. However, the design of test panels is different and the tests should be analyzed carefully. Because of the varying resistances of most inner barriers due to differences in temperature, it is very often impossible to accelerate panel tests by running them at higher temperatures.

Panels used for testing coatings or linings for immersion service should be of the same material as used in designing the vessels themselves. Size is not of too great importance, but should be in the range of from 2 in. × 4 in. to 8 in. × 12 in. Smaller panels do not allow for adequate inspection, and larger panels are difficult to handle and support. Most important factors of panel preparation are as follows:

1. All edges rounded off to 1/16 in. radius.
2. All edges smooth with *no* rough spots.
3. All holes large enough to be covered completely with the coating or lining.
4. Edges of holes rounded as in 1 and 2.
5. Plate thickness to be between $\frac{1}{8}$ in. and $\frac{3}{4}$ in.
6. Samples showing imperfection in the coating or lining application should be rejected.

Placement of the panels in the testing position is very important. Care should be taken so that no galvanic current can pass between the basic structure and the panel. The panel should be placed in a location where the most severe conditions prevail.

Frequent inspection of test panels and complete reports will aid the engineer in making a sound evaluation of the results. Evaluation of success or failure of a certain panel is sometimes difficult. Minute changes in surface appearance, such as blisters, color change, loss of gloss and under-film reaction, will indicate that a reaction has taken place. Reactions indicate failure, even though it is very minor and sometimes barely noticeable to the naked eye.

A definite standard of failure and success should be established prior to the time the tests are originated. This standard may be entirely different from that presently used for maintenance coating evaluation purposes.

Can Lining be Effectively Applied?

After consideration of the two good general guides—porosity considerations and panel testing—next step in selection of the lining is to determine if a given system can be and will be effectively applied.

In our opinion, the effectiveness of any complete lining sytem can be broken down into 10% depending on whether or not the coating itself in its final state is unaffected by the chemical exposure; 40% depending on the application technique (manner in which it is sprayed, brushed, or dipped; temperature during spraying operations; surrounding dust and humidity conditions; solid content of the liquid; amount of over-spraying, curing, pass thickness, time between coats; etc.—all of which may be quite complex and make the difference between applying a coating in the laboratory and in the shop or field); and the final 50% of the job depending on the surface preparation which will be discussed later.

However, if the coating itself is not suitable for the exposure, then that fact immediately eliminates the value of the application. No matter how well the coating is applied, or the surface prepared, if the coating is not the one for the job, failure will occur.

Thin Linings

Thin linings generally are materials which are applied by brushing, dipping, or spraying the surface of a base material in a finished film thickness of 0.006 to 0.015 in. The coatings can be air-dried, catalyzed, baked, or fused—and can be made up of organic materials, inorganic compounds or pure metallic compounds.

Organic Linings

An important part of the thin lining group are the many organic resin systems offered by several hundred manufacturers to do all kinds of jobs. The co-polymerization of different resins within the same coating to effect combination qualities is ever increasing. Paint manufacturers are developing new materials daily to try to offer better

results than those previously attained.

There would be no point in listing all of the possible synthetic resin linings, since each offers its own individual characteristics in relationship to a particular exposure.

Inorganic Linings

Another portion of the thin lining group would be the inorganic materials which, when applied to metallic surfaces, are not dependent on resin polymerization but are dependent on salt formation for their effectiveness.

Metallic Linings

A third part of the group is represented by the pure metallics—such as zinc, aluminum, and nickel. Application is by dipping, electroplating, or metallizing.

The history of metallic coatings as used for protective linings is quite extensive. The less noble metals, such as aluminum and zinc, have been used as tank linings for storage tanks and process vessels for over twenty years.

Generally, pure organic compounds have been stored in these vessels. Coating was necessary to eliminate product contamination. When the uncoated vessels were empty, rust occurred. When the tanks were refilled, this rust contaminated the product. To protect the surface against rust, aluminum or zinc (which protected the steel cathodically) was applied to the steel.

Since there was no water in the organic chemicals, rate of dissipation of the metallic coating was substantially reduced. These coatings offered an advantage in permitting washing out with water so that the tanks could be changed from one service to another.

The more noble metals, with reference to iron and steel, do not offer any protection to the base metal when applied on an individual basis—since exposure to water in any form would cause an accelerated rusting of the base metal. Therefore, the selection of the metal to be used is very important when considering the chemical to which the metal is exposed.

All of the above methods of protection within the thin lining group are dependent on the formulation of the particular system, and on their results under specific exposure. The coating manufacturer and applicator should indicate whether or not a particular system is basically sound when exposed to a given set of conditions. Frequently, it is impossible to construct historical data to substantiate a proposed use, but indications of history to similar exposure are invaluable when making a coating selection.

Combination Linings

In many cases, neither a synthetic resin lining nor metallizing gives the results desired. But a combination of the two—a sprayed metal underbase covered with a synthetic resin—offers a different system than if either of the two were used individually. When a sprayed metal such as aluminum or zinc is applied to the surface of steel to a thickness of 0.004 to 0.006 in. followed by a non-reactive synthetic resin giving a total thickness of 0.010 to 0.012 in., certain advantages are attained.

First, the bond of the sprayed metal to the steel surface is much greater than that of the paint, because a deeper etch and molecular adhesion prevails. In the case of sprayed metals, it is not necessary to worry about the relationship between the etch of the prepared surface and the thickness of the coating because the sprayed metal coating does not flow out. Therefore, it is reasonable to have a 0.003 to 0.005 in. etch and a 0.004 to 0.006 in. metallic coating since the coating will cover the peaks as well as the valleys—which is not the case when applying an organic solution paint.

Second, adhesion of the resin lining which is applied over the sprayed metallic underbase is greater than if it were applied to the base metal. The resin lining fills the pores of the metal, thereby reducing the porosity inherent in all sprayed metal. Solidification of the resin in the pores acts as a key to hold the balance of the resin on the surface. Additional resin coats are applied, offering additional protection against corrosion or contamination in the total system.

When an inert metal—such as stainless steel, nickel or tin—is used as an underbase and a non-reactive synthetic resin is applied over it, the combination offers greater resistance to the permeation of the chemical to the base metal. Even if the organic film is broken, the non-reactive underbase offers protection. It is not feasible to apply only the sprayed metal since porosity would allow the chemical to come into direct contact with the base metal. In the case of inorganic liquids, galvanic reactions would take place, thereby causing failure.

There are few restrictions as to the type of synthetic resin linings which can be applied over sprayed metals. As a result, a wide variation in possibilities, with different advantages, is attainable. Where the less noble metals are used, additional protection is obtained—due to the fact that when the organic film is broken cathodic protection occurs. Selection of the less noble metals can be made if the oxidized form does not contaminate the product within the vessel.

The combination system can be readily repaired in most cases. Failure of the synthetic resin lining film does not necessarily mean failure of the complete system. Periodic visual inspection on a maintenance basis can extend the service life of such a combination coating. If just the synthetic resin lining were used, oxidation of the base metal might occur and cause difficulties.

Selection of the proper system depends on many factors. Those experienced in the field should be consulted to determine whether or not a particular system is feasible when coming in contact with a specific exposure.

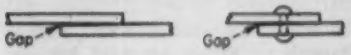
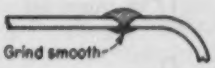
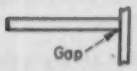
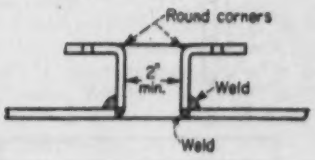
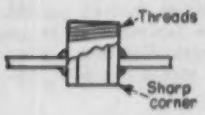
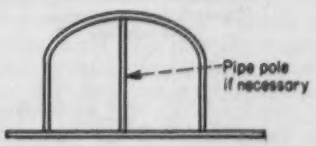
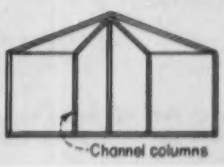
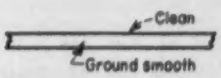
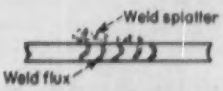
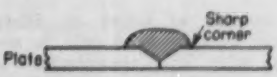
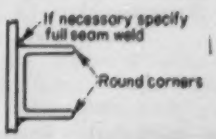
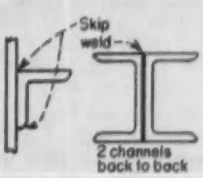
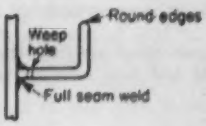
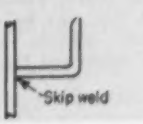
Since no material manufacturer deals in both metallizing as an undercoat and using the great variety of synthetic resin films available as a top coat, it is sometimes difficult to get specific information regarding just what these systems can do. Recently, a great deal of experimentation by certain chemical companies, as well as professional societies, has been started. Information will become available soon as to the effectiveness of these combination systems.

It is necessary to obtain from the paint manufacturers information as to whether or not they believe their particular system, or systems, may be the answer in protecting a base metal under the conditions which are prevalent.

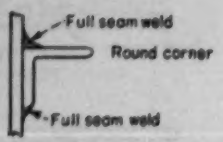
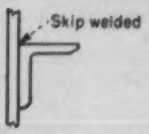
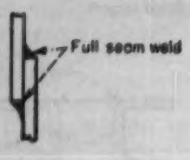
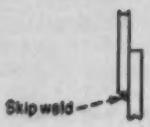
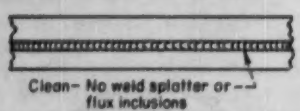
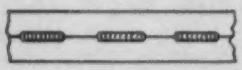
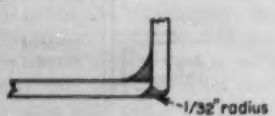
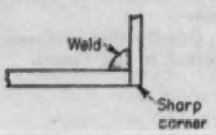
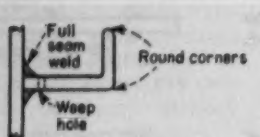
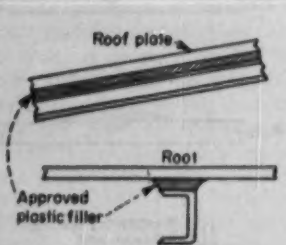
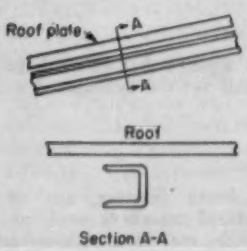
Thick Linings

Thick linings are applied to the base material by brush and spray

If You are Planning New Construction

	Do	Don't
1. Specify butt-welded vessels in preference to lap-welded or riveted vessels.		
2. Specify flanged and dished heads in preference to flat heads.		
3. Specify oversize and flanged outlets.		
4. Specify self-supporting umbrella or elliptical roof on storage vessels. **5. Where internal columns must be used, specify a minimum number and that they be tubular.**		
6. Specify that all construction involving pockets or crevices should be avoided. **7. Specify that stiffener members be external to the vessel.**		
8. Specify that all weld splatter be removed and all weld flux be removed.		
9. Specify that all welds be free of under-cutting, cracking and pinholing.		
10. Specify that all welds be ground suitable for the anticipated lining.		
11. Avoid interior use of rolled structural members such as angles, channels, etc., in a back-to-back position or lying flat against the vessel.		
12. Avoid use of any arrangement whereby the chemical is pocketed and cannot drain.		

If You Plan to Modify Existing Equipment

	Do	Don't
1. When structural members, such as channels or angles are used back-to-back or as internal stiffeners, specify that they be seal-welded on all sides where they touch other metal.		
2. Specify that all lap welds be seal-welded inside and outside. 3. Seal-welding on existing tanks should be as fast as possible and at as low a temperature as possible to avoid crystallization effects which magnify stress corrosion problems.		
4. Specify that all weld splatter and flux be removed.		
5. Specify that all welds be ground suitable for the anticipated lining.		
6. Specify that all sharp edges be ground to at least $\frac{1}{32}$ in. radius.		
7. Specify that all pockets, sections, and crevices be self-draining.		
8. Use mastics as fillers of fillets and cracks carefully and only in accordance with the manufacturer's specifications. There is a lot of feeling that mastics could be better.		

9. Approach a riveted tank with a great deal of caution. All rivets and overlapping plates should be caulked tight, and this may be a satisfactory preparation. Often, however, the "hats" on rivets and the discontinuity on laps—particularly where three plates come together—present a crevice condition unacceptable to the lining.

Once you start ringing the rivets with weld and seal welding the laps, it is necessary to do the whole tank, and this usually leads to other problems. Sometimes appropriate use of a mastic or sprayed metal can be used to make this entire problem less severe.

techniques, by troweling or by dipping. Here the method of application depends entirely on the thickness desired and the specific object to be coated.

In some cases, thick linings can be applied by all four methods. Lining thickness is greater than 0.015 in. Again, materials which are applied can be air-dried or catalyzed—and be made up of pure organic materials, inorganic materials, or pure metals.

There are certain organic resins (such as neoprene, coal tar, asphaltic, polyvinyl chloride, chlorinated rubber and furanes) which lend themselves nicely to a greater thickness build-up. Because of the increased thickness per coat and the total over-all increase in thickness, the tendency to reduce porosity is much greater. Here again, individual circumstances of exposure should dictate whether the particular lining can be used economically.

Methods of testing for porosity as outlined earlier can be used for these linings, as well as for the thinner linings. Again, it is important to determine whether porosity through the whole film can be eliminated by the application of thicker coats. One coat of a thicker coating over a pinhole is greater protection than one thin coat.

Additional protection is, of course, obtained with additional thickness. But service life, adhesion, and flexibility of the film are often important considerations when using thicker linings. Here again, combination of a metallizing undercoat and a thick lining may offer more desirable characteristics than the use of the lining alone.

Sheet Linings

Sheet linings are those materials which are applied by use of a suitable adhesive in a calendered or cast sheet form. Thickness of material applied in this manner is usually over 0.060 in., but there is no restriction as to the thickness unless it be on an economic basis.

Sheet linings for use in corrosion protection have had a good history for many years. All types of natural rubber, neoprene, polyvinyl chloride, lead, tin, fluorinated ethylenes, and the polyesters have been used in sheet form for tank lining work.

In almost all of these cases, sheets are formed by calendering thinner sheets under heat and pressure into sheets of the final thickness. If any pinholes should be present in the original sheet before calendering, the chance for those pinholes to be evident after the calendering is almost impossible because of the heat and pressure applied.

Because of the dielectric strength and the thickness, it is possible to use high voltages to determine whether pinholes do occur after the sheet has been applied to the base material.

Sheet manufacturers will be able to indicate whether their materials can be used under particular conditions. Rubber sheeting is frequently specified as either hard or soft depending on the exposure, but in many cases this specification is insufficient. It is possible to vary the compounding of these sheets to provide a better lining for a particular exposure to a greater extent than for any other compounded lining.

In specifying a rubber lining, it is wise to state the amount of reclaimed or synthetic rubber permissible—as well as the filler, if any. It is also wise to state that it must be the recommended product of one of the major rubber manufacturing companies. Application is generally quite exacting, and careful specifications of design and use are often important considerations.

Sheet linings are usually the most expensive to apply. They are not generally used where contamination is the only factor, but in severe corrosion conditions they are used extensively.

It will be noticed that there has been no discussion of the thickness of either the thin linings, the thick linings, or the sheet linings except to classify them into general groups. It is impossible to make recommendations regarding the thickness to be used, unless all details of a particular exposure are known.

Material manufacturers today have had specific experience with certain thicknesses under certain circumstances. These historical data can act as a guide.

In the case of thin linings, any recommendations of less than 0.006 in. should be questioned. In case of sheet linings, the thicker the sheet the longer it will last is a general rule.

Now that we have (1) determined the exposure and purpose of the lining, (2) examined the structure to be lined (summarized on sample check-sheet), (3) applied the basic guides of porosity considerations and test sample observations, and (4) become fairly well acquainted with the characteristics of the three lining groups with full realization that there is a big difference between selecting a good lining and getting a good lining job, we come to some of the important details in the complete lining picture that insure a good lining job.

Design Considerations

Fundamental principle in designing process equipment, from the linings point of view, is that all areas to be lined should be as smooth as possible. All sharp edges and discontinuities should be eliminated.

Reason for this is the inherent problems in the lining and its application. Any lining applied in liquid form tends to flow out or away from sharp discontinuities such as weld spatter, weld undercutting or sharp edges. Thickness of the lining is always less at these points. On an 8-mil lining over the entire surface, it is reasonable to expect not more than 1-mil over any unground edges. Changes in direction of the base material should be as gradual as possible.

Cracks, pinholes, sharp corners and even the line of contact between two pieces of metal form areas over which coatings can bridge—allowing air, moisture, and other unknown elements to be trapped behind the lining. Of course, you cannot expect an area that cannot be reached, such as angles placed back-to-back or which lie skip-welded over a plate, to be properly lined.

Sheet lining is subject to the above considerations, particularly the one of trapped air which causes major trouble in vulcanizing. The inorganic salts of the weld flux can react with either the paint or moisture to form undesirable products.

New Installations

This principle is relatively easy to apply in the design of future installations, provided that a lining has been anticipated, with the observation of a few simple guides (see drawing on p. 181).

Existing Installations

The guides above are very helpful, but a great deal of lining is done on existing vessels where conformance with these guides is woefully lacking. Even in new vessels, all of the above features may not be practical.

In these cases, problems encountered in making all surfaces smooth and satisfactory for lining become quite complex. Often a great deal of ingenuity is required to get a satisfactory surface. However, even here, there are some guides that can be followed (see drawing, p. 182).

Specifications

In general application of linings throughout a plant, there are four elementary and basic steps which should be followed: (1) program, (2) organization, (3) material, and (4) application specifications.

A program including a reference library, specifications, inspection and installation records is of the utmost importance. To service this program, a coating engineer on a part-time or full-time basis should maintain and evaluate the program.

An extremely important phase of the whole operation is a comprehensive set of application specifications which will standardize bidding and give an inspection yardstick.

General

There are usually two parts to specifications. The first could be called general. This includes overall scope, intent, instructions to bidders, insurance requirements, performance bond, company restrictions, safety requirements, etc. This section varies with every company. Specifications should include these instructions and restrictions of the purchasing, operating and legal departments.

Specific

Second part of the specifications covers the actual coating application. This means that consideration must be given to all of the items in the table. Desired items must be picked out that apply in each particular case.

What to Consider for Lining Specifications

Surface preparation
- **Preliminary cleaning**
  - Welding and grinding
    - Type rod
    - Extent of grinding
  - Scaling flame
- **Neutralizing**
- **Blasting**
  - Gen. conditions including humidity
  - Extent (classify)
  - Abrasive (use U. S. sieve series mesh)
  - Air pressure and filtration
- **Cleaning or vacuuming**
  - Type equipment
  - Extent
- **Time interval (blasting and coating)**

Application
- **General conditions**
  - Operating Conditions
- **Prime or adhesive**
  - Brushed or sprayed
  - Coverage or mil thickness required
  - General instructions (incl. number of coats)
- **Coating or lining instructions**
  - General instructions
  - Coverage or mil thickness (min. number of coats)
  - Operating conditions
- **Equipment**
  - Air or steel temperature
  - Time period
  - General instructions
- **Curing instructions**
- **Repairs**
  - Specific instructions

Safety
- **Ventilation**
  - Volume and type required
- **Lighting (specify MSA safety type)**
- **Human**
  - MSA masks, goggles—air filter type
- **General equipment precautions**

Inspection
- **Equipment**
  - In accordance with safety and mfg. specs.
- **Blasting**
- **Application**
- **Thickness**
- **Porosity**
- **Appearance (coating and area)**
- **General**

Although this is an impressive list as it stands, its expansion is extremely important. It's important that the owner be familiar enough with the operation to expand it.

There are several sources from which the engineer may gather information necessary to complete the specs. Technical literature is available in publications by the Steel Structures Painting Council, trade magazines and technical publications. Specialized applicators and consultants offer a reliable service to assist engineers in the completion of proper specifications. Additional information may be obtained from technical staffs of companies manufacturing linings.

A sample specification for a particular lining appears on p. 185.

Certain paragraphs contained therein are applicable to most specifications. However, operations such as sheet lining, metallizing, applications of organic linings over metallizing are not covered in the sample. Detail wording pertaining to such operations might follow the same general form as shown.

Experimentation

It is necessary at this point to discuss a situation which turns up surprisingly frequently to plague owner, material manufacturer, and applicator alike. The situation arises where a large application must be made and no previous history covering a completely similar case exists.

Both the manufacturer's tests and the sample plates hung in the exposure look good, but there is no history of a piece of process equipment with this particular lining in this particular exposure. Although manufacturer's tests and sample plates can give excellent evidence as to a particular lining's suitability, no tests can exactly duplicate the owner's process. Only an actual field trial can be relied upon.

This trial lining can be very expensive. Occasionally applicators have been asked to bear part or all of the field trial cost, on the basis that if it proves successful they would receive similar future work. No applicator can afford to experiment for the industry. He does not share in the savings which are of a continuing nature. Indeed, in some cases where the number of producers is small, the lining may prove so satisfactory that the appli-

Sample Specification for Lining a Vessel

Although this specification applies specifically to a sprayed lining, many of its provisions are general and apply to other types of linings as well.

General

The solvents in "X" primer are flammable, so it should be stored away from any danger of fire. During the application of "X" primer, no work should be done near an open flame. Matches, torches and smoking shall be prohibited. It is possible for dangerous solvent concentrations to accumulate in confined areas if adequate air circulation is not provided. Air circulation shall be maintained continuously during application of the primer. (See section on safety precautions for additional information on air circulation and required safety equipment.)

Forced air circulation using a centrifugal fan and heating coils shall be used for ventilation, humidity control and curing. The fan and heating unit shall be located at one of the manholes on the side of the tank, and shall be of a type where both temperature and volume of air can be controlled.

The fan shall be capable of supplying a complete change of air in the tank every six minutes or less. The heating coils shall be capable of heating this volume of air so that a curing temperature of 100 tc 130 F. can be maintained regardless of weather conditions.

From the time blasting is begun until final curing is complete, the fan and heater shall be in continuous operation to maintain the relative humidity below 50%—except during the periods when "X" lining is being sprayed and for a sufficient period afterwards to allow the overspray to settle.

Surface Preparation—Preliminary

No actual blasting or coating shall be done until after all exterior burning, welding and insulation have been completed.

All welding necessary to fill up cracks or gouges shall conform to the owner's specification # ..... covering procedures and inspection.

All protusion, sharp edges and welding spatter shall be removed by grinding smooth with a grinding wheel. All welds shall be chipped and ground smooth, preferably flush. All cracks and porous welds shall be rewelded and ground smooth. There shall be no sharp edges or rough welds that may cut the coating. All work specified in this paragraph shall be done by others, but this in no way relieves the contractor of the responsibility of seeing that no painting is done on surfaces that will be detrimental to the life of the coating.

The surface shall be absolutely free of all oil, grease, paint or chemical contamination before blasting. Any standard method may be used for removing oil or grease, but the removal of these materials must be complete. Water soluble chemicals such as acids, alkalis, or salts may be removed by thoroughly washing with warm water.

Tanks which have contained caustic shall be brush coated with Maganesed Phospholene #7 or equal, then rinsed with water before starting to blast. Bituminous or asphalt paints shall be removed by the use of suitable solvents. No attempt should be made to remove these materials by sand-blasting, unless all sand is disposed of after one pass over the surface.

Blasting

The tank shall be thoroughly dry before starting blasting operation. The relative humidity shall be kept below 50% at all times during the blasting operation.

All surfaces shall be cleaned prior to painting, using compressed air blast nozzles and Flintbrasive No. 7 or equal to a white metal finish. A white metal finish shall be that condition which covers the complete removal of all mill scale, all gray mill scale binder, all rust and all other foreign matter—thus exposing the white metal. A 5/16 in. Norbide lined nozzle with a minimum nozzle pressure of 100 psig., a minimum air supply of 200 cfm., and a nozzle distance from the surface of 12 to 18 in. is recommended.

Compressed air used for blasting shall be kept free of detrimental amounts of condensed water and oil, by using adequate separators and traps. It is recommended that a large receiver other than that on the compressor be used, where the air can cool and the moisture and oil can separate out.

Operators doing the blasting shall wear an approved helmet connected to an approved source of clean, oil-free and moisture-free compressed air.

Used abrasive particles shall not be re-used unless they are dried and screened to the original sizing.

Immediately prior to application of first prime coat and third prime coat, all grit and dust shall be thoroughly cleaned from the blasted surfaces and the scaffolding. An industrial type vacuum cleaner shall be used. Surfaces to be primed shall be cleaned until a clean white cloth is not discolored when wiped over the surface.

All surfaces, after being blasted and until completely lined, shall not be touched by bare hands—as the moisture and oil will seriously detract from the adhesion and life of the lining.

When doing the floor, all workers and other persons entering the tank shall wrap their shoes with clean rags —or wear clean heavy cotton socks.

Blasting operations shall be done in such a manner that no damage is done to partially or entirely completed portions of the work.

All blasted surfaces shall be primed as specified herein on the same day that the surfaces are blasted.

Material Application

General— Recommended procedure in coating a tank varies with the size of the tank. In general, after erection of the scaffolding, the entire tank is blasted and coated with two prime coats. The floor is then covered with clean drop cloths or wrapping paper, and the ceiling and the walls lined. The scaffolding is then removed. Spots under the scaffolding are cleaned by grinding or blasting, and primed. The third coat of primer is then applied, which should lap up the walls over the lining 2 to 3 ft. The lining is then applied to the floor—lapping up the wall not less than 4 ft. after the first ten coats.

If at any time during the application rust spots or discoloration appear on an area, that area shall be blasted to white metal finish and the primer and lining reapplied.

"X" Primer—Solvents in "X" primer are flammable, and adequate safety precautions shall be taken during its application.

Forced air ventilation shall be maintained continuously during the priming operation, and the relative humidity shall be kept below 50%.

All surfaces after being blasted and cleaned as specified herein, inspected and approved, shall receive three brush coats of "X" primer. First two coats shall be applied on the same day the surfaces are blasted, and the third coat shall be applied immediately be-

Sample Specification for Lining a Vessel—cont.

fore starting the application of "X" lining. If necessary to thin for brushing, use "X" thinner. New brushes shall be used. Succeeding coats may be applied immediately after the prior coat is dry to the touch, which is usually 20 to 40 min. Do not allow any drips or runs.

No primer shall be applied to surfaces which are at a temperature of less than 60F., or more than 95 F.

If at any time rust or discoloration is evident through the prime coats, the surface at that point shall be reblasted and primed again.

"X" Lining

General—"X" Lining contains no volatile or flammable solvents. Therefore, it presents no hazards in its application. However, standard masks should be worn while spraying. "X" lining will thicken at 50 F. and freeze at 32 F. If the material freezes, it shall be discarded.

Operating Conditions—The ventilating fan shall be stopped during the spraying of "X" lining, and for a sufficient period afterwards to allow the overspray to settle. It shall be operated between the application of successive coats for drying—which will take 30 min. to 1 hr. During the drying period, air leaving the vessel should be 90 to 100 F.

"X" lining should be screened through several thicknesses of cheesecloth before being used, to prevent clogging of the spray gun with particles of dried material and other foreign matter.

All surfaces, after being primed and inspected and approved, shall receive as many spray coats of "X" lining as necessary to obtain a coverage of 16 to 18 sq. ft. per gal. Total number of coats will be approximately 25. Final lining thickness will be approximately 20 mils (0.020 in.). Any surface when tested having less than 15 mils shall be brought up to 20 mils by spraying additional coats.

Equipment—A DeVilbiss Type MBC spray gun equipped with a No. 30 air cap and an E nozzle is recommended for spraying "X" lining. A 40 psi. pot pressure and atomizing air pressure is recommended. However, this should be adjusted for temperature, length of hose, location of spray pot, etc. The spray gun shall be adjusted for a minimum of overspray, and shall be held perpendicular to the surface. Even, parallel passes shall be made with no arching of the gun at the beginning or end of a pass.

Spraying on a given area shall be continued until the surface appears wet as reflected from the lights in the tank. The first few coats should be sprayed very lightly as the lining material has a tendency to run over the primed surface. As the thickness is built up, heavier spray coats may be applied.

New ¾" I.D. material hose shall be used. Prior to spraying clean well water shall be passed through the hose followed by the "X" lining. A dry hose may cause coagulation of the lining material in passing through.

It is neither necessary nor desirable to clean the spray equipment at the end of each day.

Curing

After application of the final coat, and after final inspection and approval, the temperature shall be raised to 110 to 120 F. in the tank and held for a minimum of 72 hr. If this temperature cannot be obtained, curing shall be accomplished by holding the tank temperature at 85 F. for 120 hr.

Repairs

After coating is completed, all surfaces shall be inspected for pinholes and blisters using spark tester or approved holiday detector. Blemishes shall be patched by cutting off the coating and reapplying the primer and lining. No scaffolding shall be removed from the tank after completion of the ceiling and side walls, until these surfaces have been inspected and approved.

Safety

The tanks shall be adequately lit with explosion proof lights. Standard MSA face masks with a clean, dry, odorless air supply shall be worn during all blasting, priming and spraying operations. Blast operators shall also wear standard MSA rubber hoods over their masks when blasting. The contractor shall observe all safety rules and work rules while on the location.

Inspection

The inspector shall at all times have access to the operations and equipment on the job. No new steps in the procedure, such as priming and lining, shall begin until he has inspected all the surfaces.

After the lining is completed he shall witness all tests for pinholes and blisters, and approve repairs. Spark testing shall be done with an approved low voltage spark tester.

Relative humidity shall be determined by using a sling type psychrometer at several points throughout the tank.

Inside steel temperature shall be determined by a pyrometer.

cator may find less business than before. Nor does an applicator or a particular lining necessarily deserve a bad reputation should the lining fail.

The owner must realize the nature of the risk and the possible return whenever he tries an unproved system, and be prepared for the expense involved.

There are methods of reducing this risk. In one major multi-plant chemical company, corrosion engineers from different parts meet periodically to exchange actual corrosion experience and information. This practice heads off many an impractical scheme.

Another major company has conducted a field trial by carefully segmenting an entire floating roof tank into five parts on which were placed sprayed zinc, sprayed zinc filled with polyvinylidene chloride, sprayed zinc filled with a vinyl, sprayed aluminum filled with polyvinylidene chloride, and sprayed aluminum which is also filled with a vinyl.

An analysis of the actual results and costs of these systems will determine the best system, and will have involved only slightly more expense than that involved in doing one complete tank with any one of the systems. In both cases, the owner expects to get something for his practice and also realizes that he must bear the expense in both cases.

Nevertheless, even in field trials, there is a definite responsibility on the part of the applicator. He must do the best job possible. To do this he not only bears a responsibility for trying to uncover all previous knowledge that might have bearing on this trial, but also works carefully with the material manufacturer and the owner in preparing and carrying out complete specifications for the lining.

A careful log of the whole application proceeding might give a clue as to what went wrong or could be improved in analyzing a job. Needless to say, the applicator should use only the best trained labor and material available. An owner must pick a reliable applicator for such a job and there must exist a spirit of mutual trust between them.

Surface Preparation

Probably the most important single factor determining the life of a

protective lining on a structure is the surface preparation of the base material.

It is generally agreed that a thoroughly cleaned surface (one completely free of rust, scale, grease, etc.) furnishes the best possible base upon which to apply a protective lining. In actual practice, however, this ideal condition can only rarely be obtained. Hence the practical problem usually becomes one of striking a suitable compromise. This compromise is only practical in cases other than concentrated vapor or immersion.

In all lining operations as previously defined, only a white metal or a SSPC #1 blast will do. The basic premise is very well summed up as follows:

"One tends to insulate a product when a paint or coating system is applied. This insulation intends to exclude detrimental products from the base material surface, yet at the same time it will also hold under the paint film any detrimental products that were not removed before the new coating was applied." Common failures caused by adhesion loss, osmotic blistering and underfilm corrosion result rather quickly when a coating is immersed.

Even though the surface is brought down to a gray metal, it is possible for sulfides and even at times paraffin to be left on the surface after blasting. Water washing and time to oxidize (in the case of sulfides), solvent cleaning and reblasting (in the case of paraffin) may be in order. There are cases where stronger reagents such as the acids must be completely neutralized after the first blast before coating or lining can proceed.

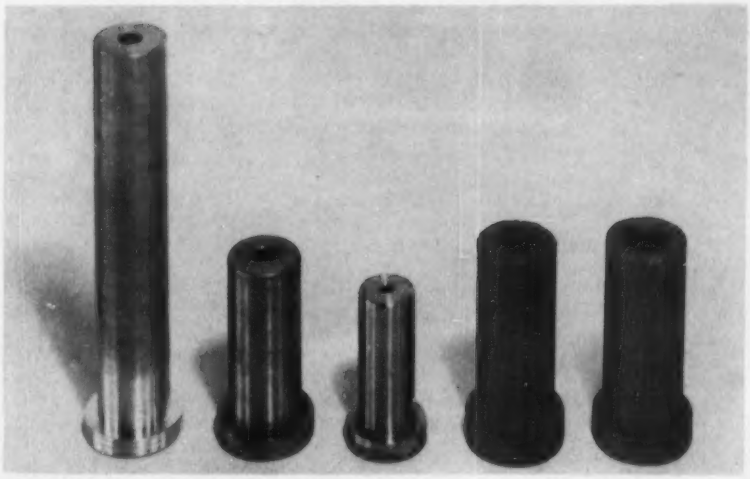
Depth of Etch Required

A great deal of thought has been given the proper selection of blast abrasive. In the case of sheet linings, metallizing, and thick linings a heavy etch is required. In the thin film synthetic linings, the etch should not exceed one-third of the final thickness from the highest peak to the lowest valley.

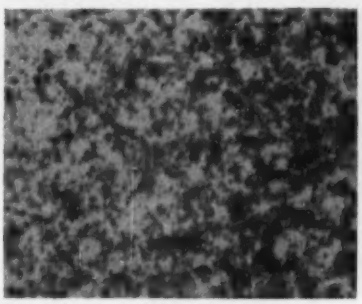
Types of Surfaces

To proceed further, it is imperative that the reader be thoroughly familiar with the blasting operation. First decision to be made is a classification of the surface involved:

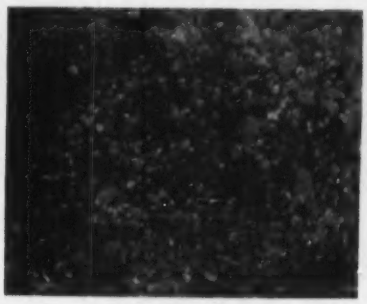
1. Steel, tight mill scale, no rust.



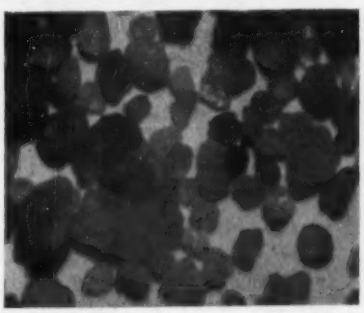
BLAST NOZZLES used in surface preparation.



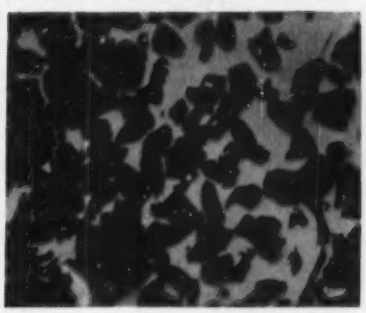
ALUMINUM OXIDE (150 mesh).



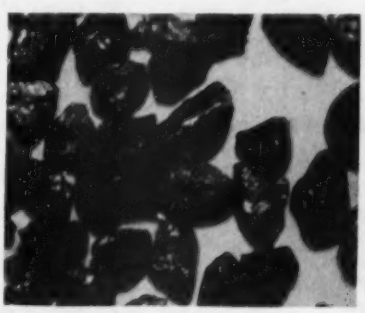
SAND (57 mesh).



BANK RUN SAND (16 and 24 mesh).



BLACK DIAMOND (16 and 24 mesh).



STEEL GRIT (G-16).

JOPLIN CHIT-CHAT (#4).

2. Weathered steel, loose mill scale, fine rust, no pits.
3. Weathered steel, no mill scale, rust, some pits.
4. Old steel, severe pitting.
5. Steel, thin lining, small percentage breakdown.
6. Steel, thin lining, overall breakdown.
7. Steel, sheet lining removed, some adhesive remaining.

Equipment requisites for the blasting operation is our next consideration. They are:

1. Adequate air supply.
2. Pressure type sandblast pot.
3. Properly sized air and blast hose.
4. Adequate ventilation.
5. Adequate lighting.

Abrasive Consumption

On the basis of a 315 cfm. compressor, a 1,400-lb. blast pot, a new ⅜ in. nozzle and a maximum 25 ft. length of ½ in. blast hose on a flat accessible area, the table below should be a fair guide.

These data should be considered average figures because of the many variables including scaffolding and hose friction loss. In some cases, previous service of a vessel has had some effect on the type of rust or scale. It is important also to realize that any change (less air capacity, lower pressure, smaller nozzle) affects the production rate and the abrasive consumed.

The commercial painting industry and many manufacturers have for years tried to reduce the importance of adequate surface preparation mainly because of competition and cost. It is time to recognize that the most important single operation of any lining is the surface preparation.

Types of Abrasives

This section would not be complete without some discussion of types of abrasives:

Natural silica sand is most commonly used for outside work where recovery is impossible. It has several disadvantages: it may lack angularity, and it may contain friable constituents of an alkaline nature which break up and cling to the surface.

Crushed flint or chat is used extensively in connection with metallizing. It owes its angularity to the conchoidal type of fracture characteristic of flint. Sources vary. Those of very high purity leave a considerable amount of material imbedded in the surface.

Crushed slag is comparatively new, but gaining acceptance. It is produced from wet-bottom furnaces. It is extremely angular with low breakdown rate, but leaves some material imbedded in surface. Tests show this material to be completely inert from a corrosion standpoint.

Angular steel grit is widely used where recovery is possible. It can be sized to give almost any desired etch. It leaves nothing on the surface.

Surface preparation and the lining operation should be considered as one job, under one contractor's responsibility. From time to time it has been suggested that two contracts be awarded, one for surface preparation and one for lining application.

Division of responsibility between contractors for the effectiveness of the lining service, the variance in time lag permissible between blasting and priming operations because of weather conditions, the method and time necessary to remove the blasting abrasive, and the time necessary to dust free the surface to be protected are all important factors. In view of the difficulties, it is almost impossible to successfully divide surface preparation and lining into two separate contracts.

COVERING tank with insulation for . . .

Etches Given by Various Abrasives (90 Psig. Air Press., ⅜" Nozzle)

Sand	Fine	Through 40 mesh	1.9 mil etch
Sand	Medium	" 18 "	2.5 " "
Sand	Large	" 12 "	2.8 " "
Grit	G-50	" 25 "	3.3 " "
Grit	G-40	" 18 "	3.6 " "
Grit	G-25	" 16 "	4.0 " "
Grit	G-16	" 12 "	8.0 " "

Abrasive Consumption (Steel Structures Painting Council #1 Blast)

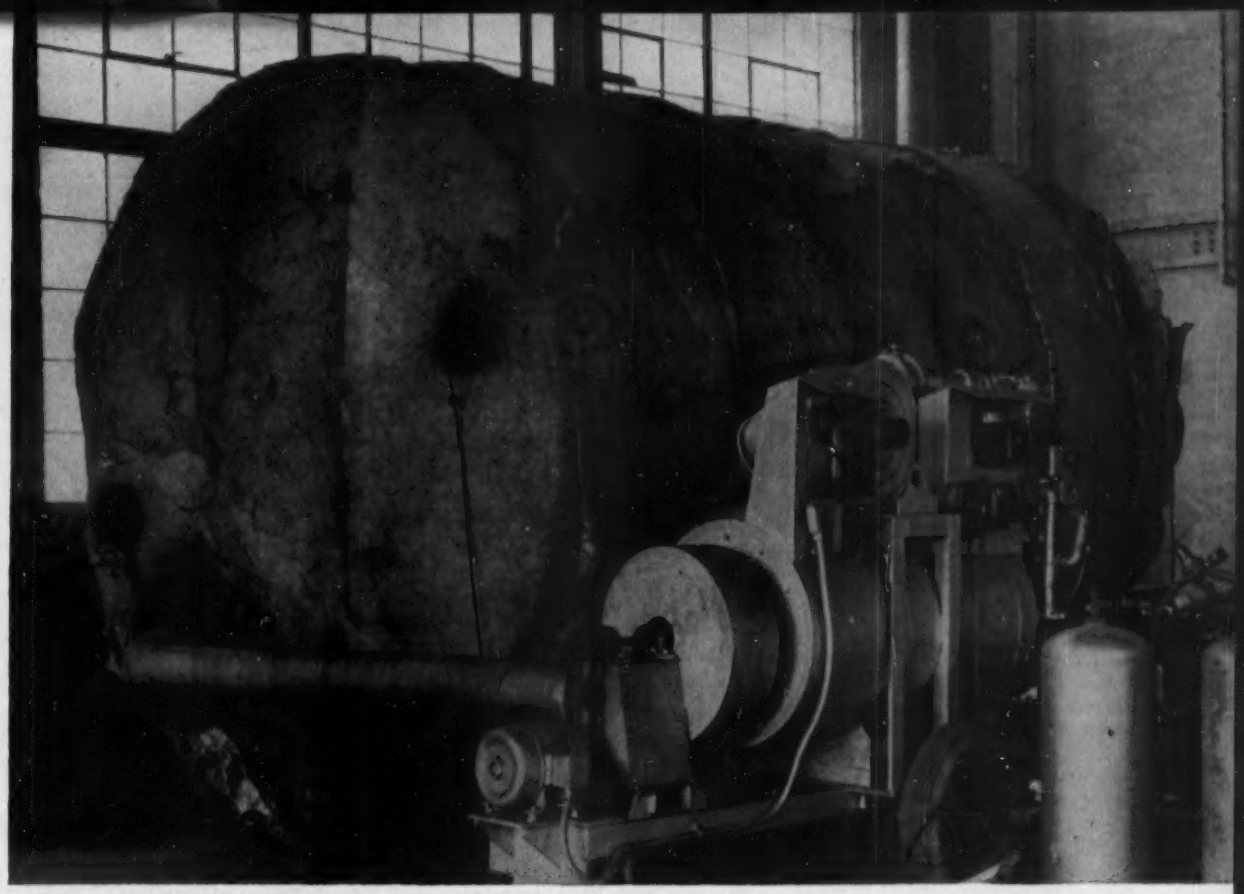
Type Surface	Sq. Ft. per Hr.	Lb. per Sq. Ft. Abrasive
1	100	12
2	120	10
3	112	10.7
4	60	20
5	70	17
6	80	15
7	50	24

Application of Linings

Sprayed Linings

It is accepted procedure to brush the first coat of a spray system over a newly blasted surface, on the assumption that any dust left on the surface will then be mixed with the liquid and the possibility of bridging small areas will be greatly reduced.

In the case of some materials, an unpigmented formulation is used for this first brush coat, or a special



CURING OPERATION for baked epoxy lining. Insulation is temporary for curing operation only.

prime. For the balance of the coats, the spray equipment should consist of the following:

- Adequate supply of clean, dry air.
- Efficient volume type air filter.
- Adequate air hose.
- Pressure or pump type spray equipment.
- Adequate paint hose.
- Spray gun with proper cap.

It is impossible to cover every sprayable material and its particular spraying characteristics. Most manufacturers can give the pot and gun pressures best suited for their materials. These will vary to some extent depending on the length of hose which must be compensated for in the field.

It is extremely important, however, that the best painting practices be used in the handling of the gun. Generally, improper handling can result in the following:

- Gun too close: excessive build-up runs.
- Gun too far: overspray—pinholes.
- Arcing gun: overspray—pinholes.
- Improper triggering: excessive build-up at lap.

Beyond these very simple operations, the method of coating edges and corners can cause an excessive build-up or light areas depending on the orientation of the gun and the spray pattern.

Forced drying of intermediate coats and final cure can present many problems, not only with baking types but also with simple systems such as the vinyls.

We have found that almost any system for constant immersion should be heated to some extent. We also choose to consider only steel temperature when setting a standard for job specifications, but in all cases there is a time-temperature relationship which must be considered. To properly perform and check this type work, the use of a portable pyrometer is absolutely essential. Heating equipment used for baking linings is generally of the direct-fired gas type. A high Btu. rating and ample blower capacity make for better circulation and more uniform heating.

Dipped or Troweled Linings

In the case of dipped or troweled linings, each manufacturer has his own method of prime and application. These are far too varied to discuss, but when deciding on their use a definite study should be made to determine the best system for the conditions.

Sheet Linings

There are many methods of application for sheet linings. They involve a series of brushed cements or adhesives.

Number of coats of cement usually depends on the operation of the vessel involved. In the case of very mild corrosives, a three-coat system is sufficient. In the case of severe corrosives or vacuum, a seven-coat system is called for.

The importance of the cementing procedure is basic. It is necessary to restrict as much as possible any under-lining reaction in the event of a break in the sheet. By specifying the maximum job, should the lining be damaged, corrosion will proceed directly through the base material and not spread out between the lining and the steel. At this point, with minor repairs, the vessel can be put back into service in relatively short order.

The lap seams vary from 1 in. to 3 in., and should be considered an important part of the job specifications.

Finally, there is the method of

FOR MEASURING steel temperature during cure: pyrometer, surface thermometer, thermocouple with temp. gage (l. to r.).

cure for any uncured rubber or neoprene. Anyone responsible for the specifications and application of sheet materials should be familiar with the several methods used. They are steam vulcanized, boil cure, hot air cure, and pre-compounded accelerator.

First and finest method of cure is steam and pressure in an autoclave. Here the pressure is maintained at approximately 50 psi. and the temperature at approximately 300F., at which point polymerization takes place. There has been no oxidation of the rubber or neoprene at this point.

Boil cures are used when autoclave vulcanization is impossible, such as when a large tank must be vulcanized in the field. Weight of the water adds considerable pressure during the cure. The hot air has a tendency to oxidize the surface of the lining. No pressure is used in the operation other than the hydraulic pressure.

Fourth method, that of a precompounded accelerator with rubber, makes it possible for the compound to polymerize at room temperature in a relatively short time. In so doing, the chemical resistance is definitely reduced. This method is normally used only in repair work, or as an overlay to permit uncured natural stock to cure in service. This type of material is usually stored at below freezing temperatures to prevent cure until ready for use.

Use of sheet stock of the plasticized polyvinyl chloride type is worthy of mention. The cementing procedure is similar to that of rubber or neoprene, but there is no cure required. All seams are butt type and heat-sealed with a sealing strip.

Inspection

Some users do not have the facilities or the ability to embark on a comprehensive testing program. In such a case, the user should deal only with manufacturers and contractors who have experience and an excellent reputation for integrity and ability. Never hesitate to ask about similar work performed for other customers. This could be called the first step of the inspection procedure.

On many lining jobs, a number of low bids may be received from contractors who have little conception of the extra requirements for lining equipment subject to continual exposure from liquids. Before allowing concerns to bid on lining contracts, it is suggested that information be obtained regarding work previously completed together with references as to experience, length of time in the field, type of equipment and experienced personnel available.

Humidity and atmospheric temperature should be checked periodically to determine whether or not they fall within the allowable ranges as stipulated by the material manufacturer. Equipment is available which can maintain these designated ranges within the vessel to be lined. On a properly engineered job there should be no difficulty in carrying out the job procedure.

Second operation that the inspector should go through would be a thorough inspection of all edges, welds, fittings, etc. Careful attention should be given to all these areas in accordance with the provisions set forth in the section on design. All preparation of this type should be complete before the area is abrasive-blasted.

Third step is the first of the physical operations on the job. Blasting should present no problem from the standpoint of inspection. Steel Structures Painting Council defines as follows (*SSPC-SP5-52T*):

"Blast clean to white metal is a method of preparing the surfaces for lining by removing all mill scale, rust, rust scale, paint, or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels.

"White metal is defined to mean a surface with a gray-white, uniform metallic color, slightly roughened to form a suitable anchor pattern for lining. The surface when viewed without magnification shall be found free of visible mill scale, rust, corrosion, oxides, paint and other foreign matter."

In all cases of linings for immersion or concentrated vapor, all foreign matter should be removed even to the deepest pits. There can be no question of economy in this statement, because any contaminant can cause rapid and complete failure.

There are some instruments used for checking the surface etch such as a micrometer depth gauge. A very simple method is to take a newly-blasted area, grind with a fine disc in a small area until no etch is visible, and place the depth gauge across the ground spot. The reading will give a reasonable idea of depth.

Attention should be given to the

abrasives as well as the equipment described in the section on surface preparation. It is not difficult to check production rates and abrasive consumption in relation to the chart in that section. Also mentioned in that section is the time interval between blasting and lining. This is directly dependent on the humidity, and should be governed by the judgment of the inspector for the particular job and atmospheric conditions encountered. This interval could vary depending on the territorial location and the time of year.

The inspector should be familiar with spray application before the application proceeds. Much information is available in Steel Structures Painting Council Manual, Vol. 1. Aside from the technique employed by the operators of the spray guns, careful attention should be given to the brushing procedure in the event the first coat is applied in that manner. Attention should be given to the thoroughness with which the paint is worked into the surface.

Welds, bolts, rivets and edges should be carefully inspected to assure adequate thickness on these critical areas. It is conceivable that an additional brush coat should be applied only in these areas. Once the spraying has commenced, every attempt should be made to reduce overspray, eliminates runs, etc., to assure top quality.

Balance of the inspection procedure can be considered in reference to the following outline:

Thin Linings:
- Liquid
  - Air-dried
  - Baked
- Metallized
  - Magnetic metals
  - Non-magnetic metals

Thick Linings

Sheet Linings

Other than procedure, the only things that can be tested in the field are (1) adhesion, (2) thickness, and (3) porosity.

Testing Thin Linings

Method for testing adhesion on thin linings is simply to cut the film and attempt to peel the lining. This is most often done on a sample plate processed with the job. Thickness can be checked with an Elcometer, a magnetic type indicator, or a coating gage which operates on battery power. Porosity can be most efficiently checked, as mentioned earlier, with a variety of electrical testers.

THICKNESS tester, wet film gage.

THICKNESS tester (Elcometer).

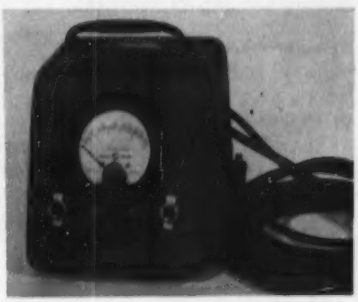
Baked linings are checked in exactly the same manner as the air-dried type, with the exception of the cure. Wetting a piece of cheesecloth with solvent and holding on the surface in an effort to detect softening is a slow and often ineffective method of checking cure. Color change on some materials, and a chart indicating steel temperature and time elements are the surest means. The time-temperature relationship is used to insure that intermediate coats are properly force-dried.

When dealing with metallizing, the inspector's first function is to visually inspect the texture of the film. This should be relatively even, and have a texture similar to that of sandpaper. There should be no heavy deposits or nodules visible on the surface. Adhesion is most often checked from a sample plate by marking a 1-in. square with a cold chisel and trying to peel the metal away.

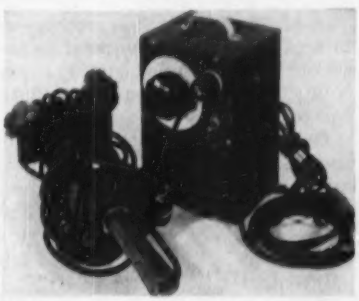
In the case of magnetic metals, the only method to check thickness is to calculate the pounds of wire required in a given area and see that it is applied. Non-magnetic metals, such as zinc and aluminum, are easily checked by the same method used for air-dried linings. Adhesion is checked in the same manner as in the case of magnetic metals.

Testing Thick Linings

Thick linings are checked in much the same way as air-dried linings. A wet film gage can be used, as well as most of the standard thick-



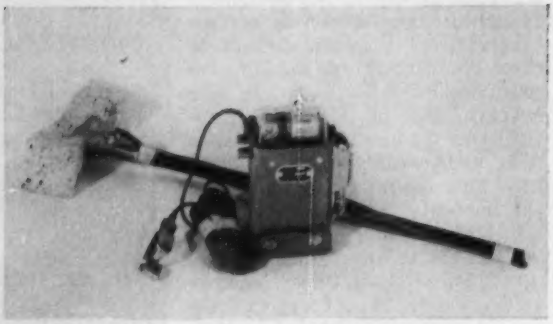
THICKNESS tester (General Electric).



PIN-HOLE detector, lo-v. dry spark.

THICKNESS tester and PIN-HOLE detector (Branson coating gage).

PIN-HOLE detector, high-frequency spark tester.



PIN-HOLE detector (Tinker and Rasor).

ness gages. Adhesion and pinhole testing are almost identical.

Testing Sheet Linings

Sheet linings are always checked with a high voltage spark tester, up to 15,000 volts.

Probably the only way to check cure, other than by temperature and time charts, is by the durometer reading. The manufacturer should be able to give this figure for his cured stock.

Safety Precautions

Solvents and thinners used in applying most linings are often volatile and flammable. Therefore, certain safety precautions must be observed while these coatings are being applied within a confined space, such as a tank.

Ordinarily, applications made in the open air where ventilation is unrestricted present no special hazards. In these cases, it is sufficient to prohibit smoking, sparks and open flames within a 50 ft. radius of the application site.

When applying these volatile products inside a tank or in other places where circulation of air is restricted, sufficient ventilation must be provided to keep the concentration of solvent vapor below the lower explosive limit. Lower explosive limit refers to the volume of solvent vapor in air which is just below the point at which an explosion will occur if the mixture is ignited with a flame or spark. If the concentration of solvent vapor does not reach the lower explosive limit, no explosion can occur.

Adequate ventilation is, therefore, the key to safe application. It follows that if the applicator provides adequate ventilation and takes recommended precautions against open flames and sparks, any hazard from fire or explosion will be negligible.

It is important to know what solvents are present. Vapors from all organic solvents are unsuitable for breathing in high concentrations. A sharp or pungent odor is not a reliable indication of either the concentration or the toxicity of a solvent. A toxic concentration of carbon tetrachloride or benzene vapors will not have a particularly strong or unpleasant odor. On the other hand, a toxic concentration of many frequently used solvents would be almost unbearable because of irritation to the eyes and mucous membrane.

These latter solvents, therefore, have excellent warning properties. A definite stinging sensation in the eyes and nose will occur at concentrations well below a toxic level, thereby indicating that more ventilation will be needed. Even when using these solvents, however, the dual precaution should be taken to provide adequate ventilation and to require the use of compressed air masks by all workmen inside the tank. By so doing, any hazard to health will be made negligible, and discomfort will be eliminated.

Safety Rules

The following rules summarize the precautions to be observed when applying linings within a tank or other confined area:

1. Provide sufficient ventilation to keep the solvent concentration in all parts of the tank below the lower explosive limit. The ventilation must be maintained during the entire application period, and for at least three hours thereafter.

2. Remove the solvent vapors from the tank by suction. Do not force air from the outside into the tank. Most lining solvents are heavier than air and, therefore, tend to settle in the lowest part of the tank. In setting up the ventilation system, the most remote and the lowest areas should receive special attention.

3. Use explosion-proof and spark-proof equipment. All electric cable, motors and lighting equipment must be of an approved explosion-proof type. No electric junction boxes should be permitted inside the tank. Drop lights used by the workmen must also be explosion-proof. Workmen should be cautioned not to cut or stretch electric cables since sparks will result if the cable parts. Within the hazardous area, all metal equipment and hand tools must be of a non-sparking type. Workmen's shoes must have rubber soles and heels.

4. Smoking, matches, flames or sparks of any kind should be prohibited within 50 ft. of the application area.

5. Require the use of an approved compressed air mask by all workmen in tanks and closely confined areas. Such compressed air masks are available from a number of sources, including the DeVilbiss Co., Toledo, Ohio, and Mine Safety Appliances Co., Pittsburgh, Pa. A compressed air mask is the only type which should be used.

6. Compressed air supplied to the breathing masks should be as clean and dry as possible, and at a low temperature. Without exception there should be a filter in the breathing air line. This should contain some ingredient such as activated charcoal for removing any organic materials.

7. Workmen should constantly check to see that the ventilation apparatus is working and know what to do in case it fails (immediately stop air flow to the spray guns and warn men in the tank).

8. No one should ever enter a closed vessel without a watcher on the outside.

9. Attention should be paid to making all scaffolding as strong, safe and simple as practical. Every man with a face mask or blasting hood on, and surrounded with hoses and wires, is somewhat clumsy and cannot move as an unencumbered man.

10. Attention should be paid to establishing a few simple signals for communication between the operator and those outside.

11. Use gas detectors or vapor concentration measuring devices whenever entering a used tank.

12. Use approved blasting hoods.

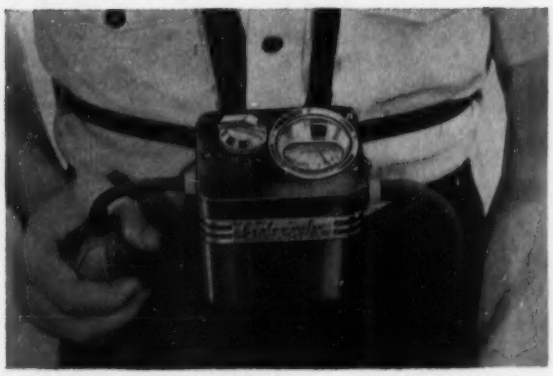
Comparative Costs

The accompanying bar charts give costs for process equipment (1) unlined, and (2) lined with different materials.

Prices for the tanks are quite representative of the present day costs (probably within 10%), particularly for all shop fabricated tanks and the larger field erected tanks. In the cases of the 10,000 and 20,000-gal. field erected tanks, the mild steel price is subject to considerable variation (possibly as much as 30%), depending on how much it is possible to pre-fabricate in the shop, difficulties encountered in the field, etc.

Design of the tanks is close to usual practice—which is to use standard width plate, with the height approximately equal to the base. All tanks are non code.

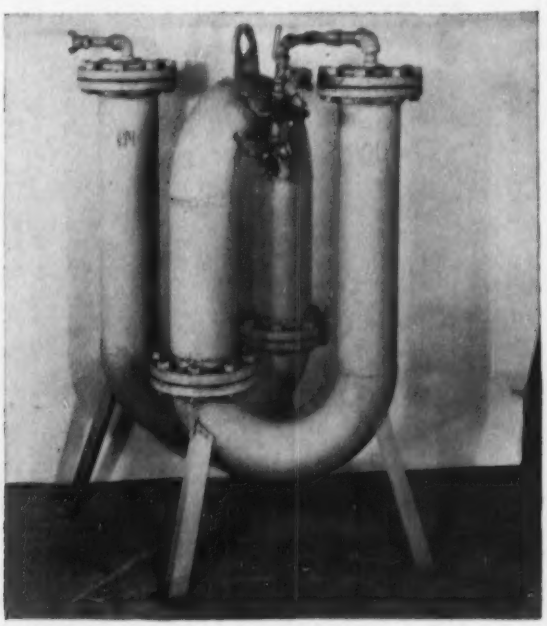
Lining costs were figured for



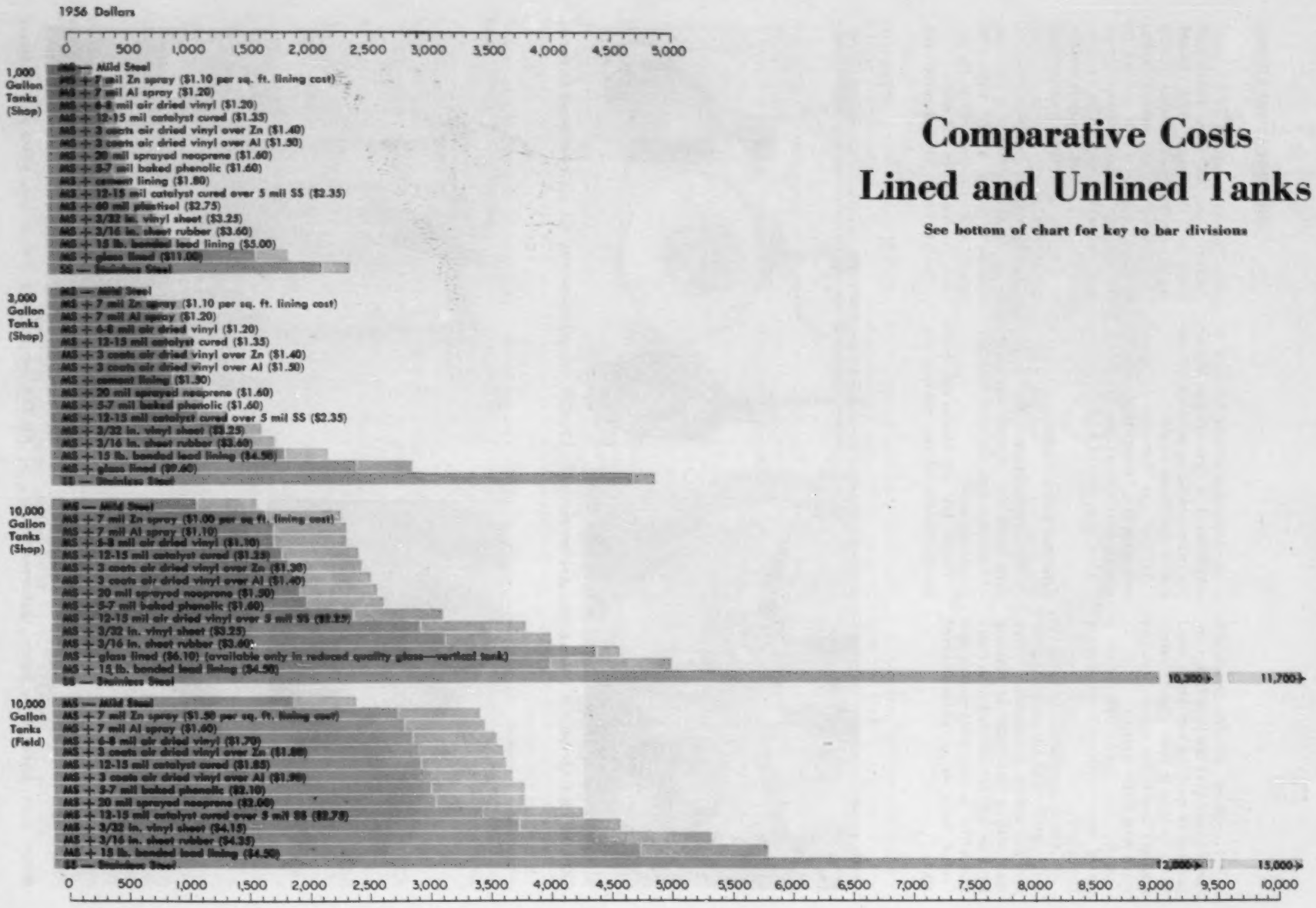
EXPLOSIVE-GAS detector (Mine Safety Appliances Co.).

LIGHTS, non-explosion-proof (l), explosion-proof (c. & r.).

HOOD, mask, gloves (Mine Safety Appliances Co.).

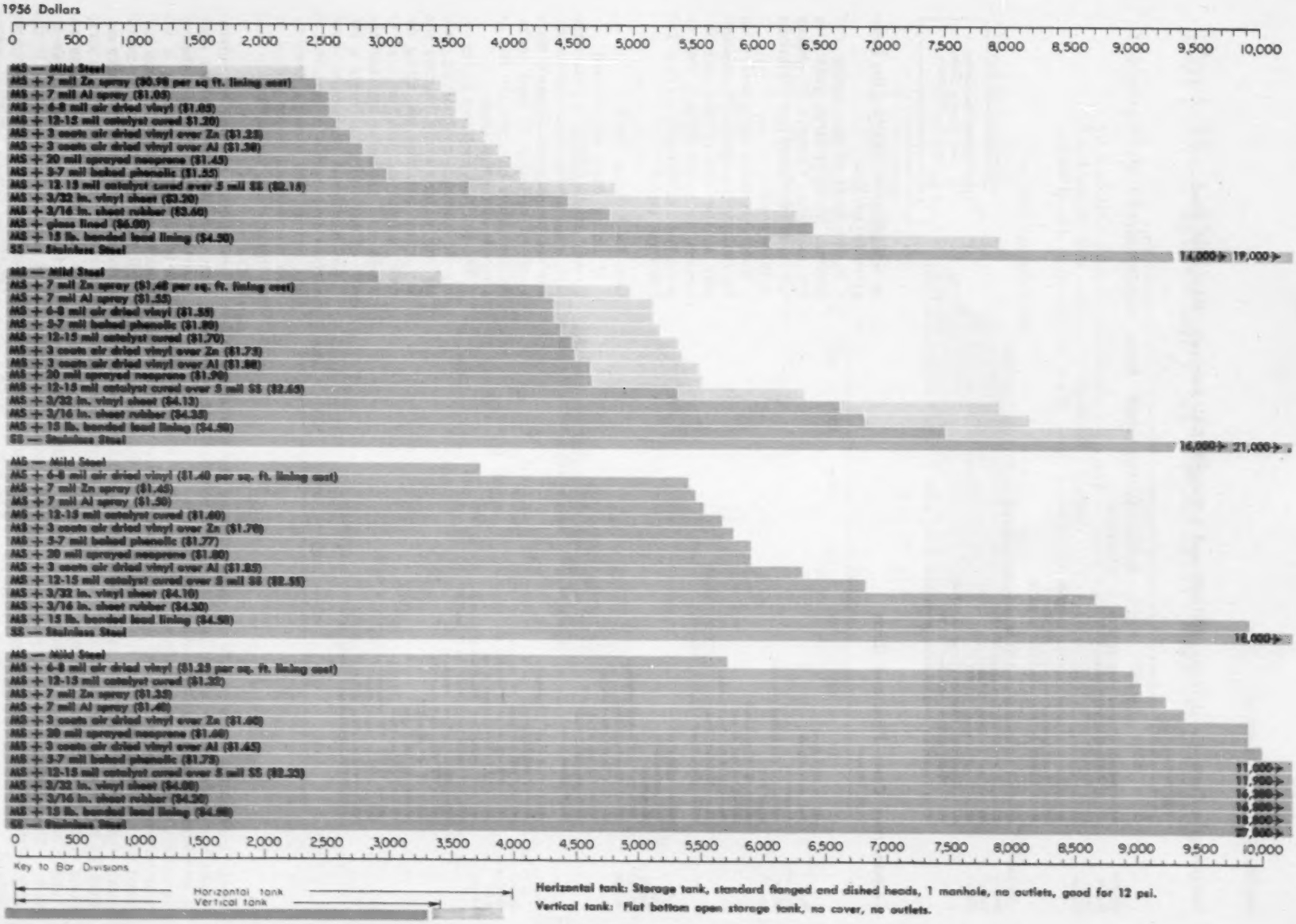


FILTER for air lines with carbon, water and oil traps.


1956 Dollars
0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000
1,000 Gallon Tanks (Shop)
MS — Mild Steel
MS + 7 mil Zn spray ($1.10 per sq. ft. lining cost)
MS + 7 mil Al spray ($1.20)
MS + 6-8 mil air dried vinyl ($1.20)
MS + 12-15 mil catalyst cured ($1.35)
MS + 3 coats air dried vinyl over Zn ($1.40)
MS + 3 coats air dried vinyl over Al ($1.50)
MS + 20 mil sprayed neoprene ($1.60)
MS + 5-7 mil baked phenolic ($1.60)
MS + cement lining ($1.80)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.35)
MS + 60 mil plastisol ($2.75)
MS + 3/32 in. vinyl sheet ($3.25)
MS + 3/16 in. sheet rubber ($3.60)
MS + 15 lb. bonded lead lining ($5.00)
MS + glass lined ($11.00)
SS — Stainless Steel
3,000 Gallon Tanks (Shop)
MS — Mild Steel
MS + 7 mil Zn spray ($1.10 per sq. ft. lining cost)
MS + 7 mil Al spray ($1.20)
MS + 6-8 mil air dried vinyl ($1.20)
MS + 12-15 mil catalyst cured ($1.35)
MS + 3 coats air dried vinyl over Zn ($1.40)
MS + 3 coats air dried vinyl over Al ($1.50)
MS + cement lining ($1.50)
MS + 20 mil sprayed neoprene ($1.60)
MS + 5-7 mil baked phenolic ($1.60)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.35)
MS + 3/32 in. vinyl sheet ($3.25)
MS + 3/16 in. sheet rubber ($3.60)
MS + 15 lb. bonded lead lining ($4.50)
MS + glass lined ($9.60)
SS — Stainless Steel
10,000 Gallon Tanks (Shop)
MS — Mild Steel
MS + 7 mil Zn spray ($1.00 per sq. ft. lining cost)
MS + 7 mil Al spray ($1.10)
MS + 5-8 mil air dried vinyl ($1.10)
MS + 12-15 mil catalyst cured ($1.25)
MS + 3 coats air dried vinyl over Zn ($1.30)
MS + 3 coats air dried vinyl over Al ($1.40)
MS + 20 mil sprayed neoprene ($1.50)
MS + 5-7 mil baked phenolic ($1.60)
MS + 12-15 mil air dried vinyl over 5 mil SS ($2.25)
MS + 3/32 in. vinyl sheet ($3.25)
MS + 3/16 in. sheet rubber ($3.60)
MS + glass lined ($6.10) (available only in reduced quality glass—vertical tank)
MS + 15 lb. bonded lead lining ($4.50)
SS — Stainless Steel
10,300+
11,700+
10,000 Gallon Tanks (Field)
MS — Mild Steel
MS + 7 mil Zn spray ($1.50 per sq. ft. lining cost)
MS + 7 mil Al spray ($1.60)
MS + 6-8 mil air dried vinyl ($1.70)
MS + 3 coats air dried vinyl over Zn ($1.80)
MS + 12-15 mil catalyst cured ($1.85)
MS + 3 coats air dried vinyl over Al ($1.90)
MS + 5-7 mil baked phenolic ($2.10)
MS + 20 mil sprayed neoprene ($2.00)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.75)
MS + 3/32 in. vinyl sheet ($4.15)
MS + 3/16 in. sheet rubber ($4.35)
MS + 15 lb. bonded lead lining ($4.50)
SS — Stainless Steel
12,000+
15,000+
0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000 5,500 6,000 6,500 7,000 7,500 8,000 8,500 9,000 9,500 10,000

Comparative Costs Lined and Unlined Tanks

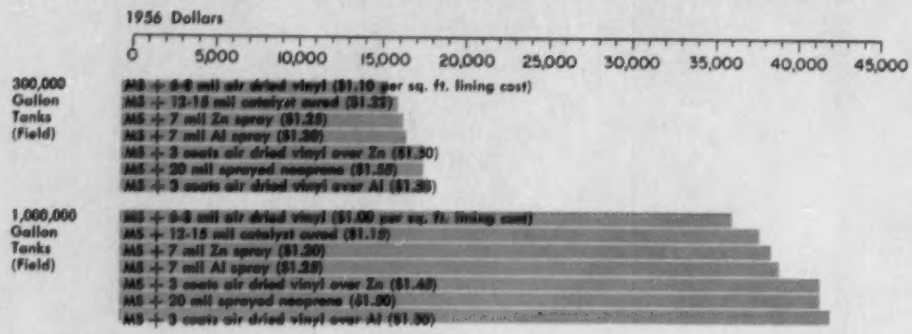
See bottom of chart for key to bar divisions


1956 Dollars
0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000 5,500 6,000 6,500 7,000 7,500 8,000 8,500 9,000 9,500 10,000
20,000 Gallon Tanks (Shop)
MS — Mild Steel
MS + 7 mil Zn spray ($0.98 per sq. ft. lining cost)
MS + 7 mil Al spray ($1.05)
MS + 6-8 mil air dried vinyl ($1.05)
MS + 12-15 mil catalyst cured $1.20)
MS + 3 coats air dried vinyl over Zn ($1.23)
MS + 3 coats air dried vinyl over Al ($1.38)
MS + 20 mil sprayed neoprene ($1.45)
MS + 5-7 mil baked phenolic ($1.55)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.18)
MS + 3/32 in. vinyl sheet ($3.20)
MS + 3/16 in. sheet rubber ($3.60)
MS + glass lined ($6.00)
MS + 15 lb. bonded lead lining ($4.50)
SS — Stainless Steel
14,000+ 19,000+
20,000 Gallon Tanks (Field)
MS — Mild Steel
MS + 7 mil Zn spray ($1.48 per sq. ft. lining cost)
MS + 7 mil Al spray ($1.55)
MS + 6-8 mil air dried vinyl ($1.55)
MS + 5-7 mil baked phenolic ($1.80)
MS + 12-15 mil catalyst cured ($1.70)
MS + 3 coats air dried vinyl over Zn ($1.73)
MS + 3 coats air dried vinyl over Al ($1.88)
MS + 20 mil sprayed neoprene ($1.90)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.65)
MS + 3/32 in. vinyl sheet ($4.13)
MS + 3/16 in. sheet rubber ($4.35)
MS + 15 lb. bonded lead lining ($4.50)
SS — Stainless Steel
16,000+ 21,000+
30,000 Gallon Tanks (Field)
MS — Mild Steel
MS + 6-8 mil air dried vinyl ($1.40 per sq. ft. lining cost)
MS + 7 mil Zn spray ($1.45)
MS + 7 mil Al spray ($1.50)
MS + 12-15 mil catalyst cured ($1.60)
MS + 3 coats air dried vinyl over Zn ($1.70)
MS + 5-7 mil baked phenolic ($1.77)
MS + 20 mil sprayed neoprene ($1.80)
MS + 3 coats air dried vinyl over Al ($1.85)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.55)
MS + 3/32 in. vinyl sheet ($4.10)
MS + 3/16 in. sheet rubber ($4.30)
MS + 15 lb. bonded lead lining ($4.50)
SS — Stainless Steel
18,000+
100,000 Gallon Tanks (Field)
MS — Mild Steel
MS + 6-8 mil air dried vinyl ($1.23 per sq. ft. lining cost)
MS + 12-15 mil catalyst cured ($1.32)
MS + 7 mil Zn spray ($1.35)
MS + 7 mil Al spray ($1.40)
MS + 3 coats air dried vinyl over Zn ($1.60)
MS + 20 mil sprayed neoprene ($1.60)
MS + 3 coats air dried vinyl over Al ($1.65)
MS + 5-7 mil baked phenolic ($1.75)
MS + 12-15 mil catalyst cured over 5 mil SS ($2.33)
MS + 3/32 in. vinyl sheet ($4.00)
MS + 3/16 in. sheet rubber ($4.20)
MS + 15 lb. bonded lead lining ($4.40)
SS — Stainless Steel
11,000+
11,900+
16,300+
16,500+
18,500+
27,500+
0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000 5,500 6,000 6,500 7,000 7,500 8,000 8,500 9,000 9,500 10,000
Key to Bar Divisions
Horizontal tank
Vertical tank

Horizontal tank: Storage tank, standard flanged and dished heads, 1 manhole, no outlets, good for 12 psi.

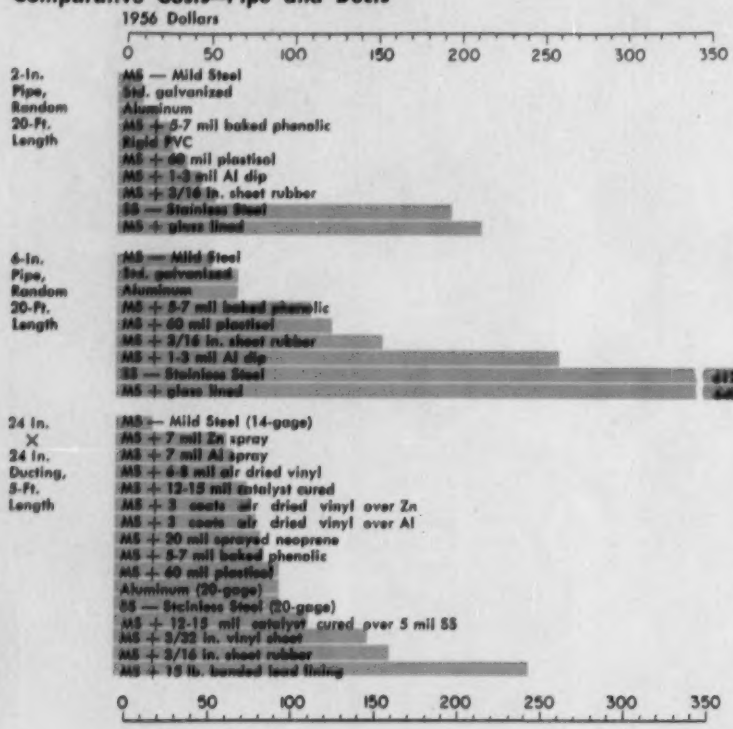
Vertical tank: Flat bottom open storage tank, no cover, no outlets.

Comparative Costs—Lined Tanks, 300,000 and 1,000,000 Gal. Vertical. MS = Mild Steel


1956 Dollars
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
300,000 Gallon Tanks (Field)
MS + 6-8 mil air dried vinyl ($1.10 per sq. ft. lining cost)
MS + 12-15 mil catalyst cured ($1.23)
MS + 7 mil Zn spray ($1.25)
MS + 7 mil Al spray ($1.20)
MS + 3 coats air dried vinyl over Zn ($1.30)
MS + 20 mil sprayed neoprene ($1.55)
MS + 3 coats air dried vinyl over Al ($1.35)
1,000,000 Gallon Tanks (Field)
MS + 6-8 mil air dried vinyl ($1.00 per sq. ft. lining cost)
MS + 12-15 mil catalyst cured ($1.15)
MS + 7 mil Zn spray ($1.20)
MS + 7 mil Al spray ($1.25)
MS + 3 coats air dried vinyl over Zn ($1.40)
MS + 20 mil sprayed neoprene ($1.80)
MS + 3 coats air dried vinyl over Al ($1.50)

Vertical, flat bottom, open storage tanks, no cover, no outlets.

Comparative Costs—Pipe and Ducts



newly constructed representative tanks in each size group—assuming a minimum of complications such as outlets, inside stiffeners, baffles, ease of access to job, etc. For shop lined work, it is assumed that adequate facilities are available and that the larger shop work would be done right on a railroad flat car (under cover and using turning rolls). These lining costs are probably within 5% for the tanks as figured.

When large amounts of special work—such as cutting, fitting, hand-tailoring and special scaffolding—are involved, lining costs can vary widely.

Prices include surface preparation by blasting, but no extra preparation such as welding, grinding sharp edges, caulking, filling cracks, sealing, etc. The latter can add considerably to the cost of the job. Costs shown would be low if the tanks were of riveted construction, particularly in the case of rubber lining. If field erected tanks are on upper floors, or in such a position that access to the tank is not easy or equipment is crowded, the costs given are too low.

In the cases of the piping and ducting, relatively large quantities are assumed. Changes in shapes can cause very large cost variations in these cases.

Note that price per gallon ratio for tank storage drops off considerably as the size of the tank increases. It is only about 1/10th as much for 1 million gal. tanks as for 1,000 gal. tanks.

Costs for Existing Tanks

If lining costs are desired for already existing tanks, subtract the mild steel prices shown. However, surface preparation is much more given to variation in used tanks. So the prices obtained are not as accurate as for new tanks.

You run into problems of removing old coatings, neutralizing, acid etching, water rinsing, blasting and reblasting, patching and filling defects, solvent cleaning, etc.—all of which will probably increase the cost of any lining job quite a bit.

As mentioned elsewhere, good surface preparation is essential to any lining. The blasting preparation represents a major portion of all lining costs, particularly in field work.

Lead lining has one big advantage over the other linings costwise that is not indicated in the bar charts, where it apparently is the most expensive lining. When a lead lined tank has finished its useful service, about 60% of the lining material cost can be recovered as scrap lead. No other lining has any appreciable salvage value. However, lead has its disadvantages. If the lining is ever punctured, chemicals can spread rapidly behind it—causing severe damage to the base material.

Part II—Directory of Construction Materials

Classification of Materials and Key to Manufacturers. Table I

To find who makes construction materials listed under various generic classifications in this table, see Table II, p. 200. (Note that the indicated compositions are approximate only, sometimes with minor constituents omitted.)

MATERIAL CLASSIFICATION	MAT'L. CODE	MANUFACTURERS' CODE NUMBERS
Metallic materials		
1. Ferrous metals and alloys		
1. Irons		
1. Gray cast iron (2–5 C)	1.1.1	1, 81
2. Nickel cast iron	1.1.2	1, 47, 81, 99
3. High silicon cast iron (14.5 Si)	1.1.3	44, 99
4. Ductile cast iron	1.1.4	81
5. Electrolytic iron (0.006 C)	1.1.5	
6. Wrought iron (0.05–0.15 C)	1.1.6	19
7. Other irons	1.1.7	13, 25, 84
2. Carbon steels (0.02–1.50 C)		
1. Wrought	1.2.1	32, 83, 97, 132
2. Cast	1.2.2	1, 47, 49
3. Carbon steels combined (clad, bonded) with:		
1. Copper	1.3.1	
2. Glass	1.3.2	59, 102
3. Lead	1.3.3	3, 96
4. Nickel	1.3.4	3, 14, 32, 83
5. Nickel-chromium alloy	1.3.5	3, 83
6. Nickel-copper alloy	1.3.6	3, 83
7. Plastic	1.3.7	
8. Rubber	1.3.8	
9. Stainless steel	1.3.9	3, 32, 45, 83
10. Other combined	1.3.10	
4. Alloy steels (wrought or cast)		
1. Moly	1.4.1	1, 13, 32, 47, 49, 97, 120, 125
2. Nickel	1.4.2	1, 13, 47, 49, 97, 122, 125
3. Chrome	1.4.3	1, 32, 47, 97, 122, 125
4. Chrome-moly	1.4.4	1, 13, 32, 47, 49, 97, 120, 122, 125
5. Chrome-nickel	1.4.5	1, 47, 97, 122, 125
6. Other alloy steels	1.4.6	1, 32, 47, 49, 97, 120, 122, 125, 134
5. Wrought stainless steels (AISI types):		
1. 301 (16–18 Cr; 6–8 Ni; 0.08–0.15 C)	1.5.1	4, 38, 45, 89, 115, 122, 125, 130
2. 302 (17–19 Cr; 8–10 Ni; 0.08–0.15 C)	1.5.2	4, 13, 24, 38, 45, 89, 97, 115, 118, 122, 125, 130
3. 302B (17–19 Cr; 8–10 Ni; 0.08–0.15 C; 2–3 Si)	1.5.3	4, 13, 38, 122, 125
4. 303 (17–19 Cr; 8–10 Ni; 0.15 max. C; 0.07 min. P or S or Se; 0.6 max. Zr or Mo; 2 max. Mn)	1.5.4	4, 13, 24, 38, 45, 97, 122, 125
5. 304 (18–20 Cr; 8–11 Ni; 0.08 max. C; 2 max. Mn)	1.5.5	4, 13, 16, 24, 38, 45, 83, 89, 97, 115, 118, 120, 122, 125, 130
6. 304L (18–20 Cr; 8–11 Ni; 0.03 max. C)	1.5.6	4, 13, 16, 24, 38, 45, 83, 89, 97, 115, 118, 125, 130
7. 305 (17–19 Cr; 10–13 Ni; 0.012 max. C)	1.5.7	4, 13, 38, 45, 89, 115, 118, 125, 130
8. 308 (19–21 Cr; 10–12 Ni; 0.08 max. C)	1.5.8	4, 13, 38, 45, 118, 125
9. 309 (22–24 Cr; 12–15 Ni; 0.2 max. C)	1.5.9	4, 13, 16, 38, 115, 118, 122, 125, 130
10. 309S (22–24 Cr; 12–15 Ni; 0.08 max. C)	1.5.10	4, 13, 16, 25, 38, 45, 115, 120, 122, 125, 130
11. 310 (24–26 Cr; 19–22 Ni; 0.25 max. C)	1.5.11	4, 13, 38, 97, 115, 118, 122, 125, 130
12. 310S (24–26 Cr; 19–22 Ni; 0.08 max. C)	1.5.12	4, 13, 25, 38, 45, 115, 120, 125
13. 314 (23–26 Cr; 19–22 Ni; 0.25 max. C; 1.5–3 Si)	1.5.13	4, 38, 45, 118, 122, 125
14. 316 (16–18 Cr; 10–14 Ni; 0.1 max. C; 1.75–2.75 Mo)	1.5.14	4, 13, 16, 24, 38, 45, 83, 89, 97, 115, 118, 120, 122, 125, 130
15. 316L (16–18 Cr; 10–14 Ni; 2–3 Mo; 0.03 max. C)	1.5.15	4, 13, 16, 24, 38, 45, 83, 89, 97, 115, 118, 125, 130
16. 317 (17.5–20 Cr; 10–14 Ni; 0.1 max. C; 3–4 Mo)	1.5.16	4, 13, 24, 25, 38, 45, 83, 97, 115, 118, 122, 125, 130
17. 321 (17–19 Cr; 8–11 Ni; 5XC min. Ti)	1.5.17	4, 13, 16, 24, 38, 45, 83, 89, 97, 115, 118, 120, 122, 125, 130
18. 347 (17–19 Cr; 9–12 Ni; 10XC min. Cb)	1.5.18	4, 13, 16, 24, 25, 38, 45, 83, 89, 97, 115, 118, 120, 122, 125, 130
19. 403 (11.5–13 Cr; 0.15 max. C)	1.5.19	4, 13, 16, 24, 38, 97, 120, 125
20. 405 (11.5–13.5 Cr; 0.08 max. C; 0.1–0.3 Al)	1.5.20	4, 13, 38, 97, 122, 125
21. 410 (11.5–13.5 Cr; 0.15 max. C)	1.5.21	4, 13, 16, 24, 38, 45, 89, 97, 120, 125, 130
22. 414 (11.5–13.5 Cr; 1.25–2.5 Ni; 0.15 max. C)	1.5.22	4, 13, 24, 38, 97, 125, 130
23. 416 (12–14 Cr; 0.15 max. C; 0.07 min. S or P or Se; 0.6 max. Zr or Mo)	1.5.23	4, 13, 24, 38, 97, 125
24. 420 (12–14 Cr; 0.15 min. C)	1.5.24	4, 13, 16, 38, 125
25. 430 (14–18 Cr; 0.12 max. C)	1.5.25	4, 13, 16, 24, 38, 45, 97, 118, 125, 125, 130
26. 430F (14–18 Cr; 0.12 max. C; 0.07 min. S or P or Se: 0.6 max. Zr or Mo)	1.5.26	4, 13, 24, 38, 125
27. 431 (15–17 Cr; 1.25–2.5 Ni; 0.2 max. C)	1.5.27	4, 13, 38, 125
28. 440A (16–18 Cr; 0.6–0.75 C; 0.75 max. Mo)	1.5.28	4, 13, 24, 38, 125
29. 440B (16–18 Cr; 0.75–0.95 C; 0.75 max. Mo)	1.5.29	4, 13, 24, 38, 125
30. 440C (16–18 Cr; 0.95–1.2 C; 0.75 max. Mo)	1.5.30	4, 13, 24, 38, 125
31. 446 (23–27 Cr; 0.35 max. C; 0.25 max. N)	1.5.31	4, 13, 16, 25, 38, 122, 125
32. 501 (4–6 Cr; 0.1 min. C)	1.5.32	4, 38, 125
33. 502 (4–6 Cr; 0.1 max. C)	1.5.33	4, 38, 125
6. Cast high alloys (ACI types):		
1. CA-15 (11–14 Cr; 1 max. Ni; 0.15 max. C)	1.6.1	1, 20, 34, 38, 41, 44, 47
2. CA-40 (11–14 Cr; 1 max. Ni; 0.2– 0.4 C)	1.6.2	1, 20, 34, 38, 41, 47
3. CB-30 (18–22 Cr; 2 max. Ni; 0.3 max. C)	1.6.3	1, 20, 34, 38, 41, 47
4. CC-50 (26–30 Cr; 4 max. Ni; 0.5 max. C)	1.6.4.	1, 20, 34, 38, 41, 47
5. CE-30 (26–30 Cr; 8–11 Ni; 0.3 max. C)	1.6.5.	1, 20, 34, 38, 41, 47
6. CF-8 (18–20 Cr; 8–10 Ni; 0.08 max. C)	1.6.6	1, 20, 34, 38, 41, 44, 47, 99

MATERIAL CLASSIFICATION		MAT'L. CODE	MANUFACTURERS' CODE NUMBERS
7. CF-20	(18–20 Cr; 8–10 Ni; 0.2 max. C)	1.6.7	1, 20, 34, 38, 41, 47, 99
8. CF-16F	(18–20 Cr; 8–10 Ni; 0.08 max. C; 0.2–0.35 Se)	1.6.8	1, 20, 34, 38, 41, 47
9. CF-8C	(18–20 Cr; 8–10 Ni; 0.08 max. C; 8XC min.-1 max. Cb)	1.6.9	1, 20, 34, 38, 41, 47
10. CF-8M	(18–20 Cr; 8–10 Ni; 0.08 max. C; 2–3 Mo)	1.6.10	1, 20, 34, 38, 41, 44, 47, 99
11. CF-12M	(18–20 Cr; 8–10 Ni; 0.12 max. C; 2–3 Mo)	1.6.11	20, 34, 38, 41, 47
12. CH-20	(22–26 Cr; 12–15 Ni; 0.2 max. C)	1.6.12	1, 20, 34, 38, 41, 44, 47, 99
13. CK-20	(23–75 Cr; 19–22 Ni; 0.25 max. C)	1.6.13	1, 20, 34, 38, 41, 47
14. CN-7M	(18–22 Cr; 21–31 Ni; 0.07 max. C)	1.6.14	1, 20, 34, 38, 41, 44, 47, 133
15. HA	(8–10 Cr; 0 Ni; 0.2 max. C; 0.9–1.2 Mo)	1.6.15	20, 38, 41, 47
16. HC	(26–30 Cr; 4 max. Ni)	1.6.16	20, 34, 38, 41, 47
17. HD	(26–30 Cr; 3–6 Ni)	1.6.17	20, 34, 38, 41, 47
18. HE	(26–30 Cr; 8–11 Ni)	1.6.18	20, 34, 38, 41, 47
19. HF	(18–23 Cr; 8–12 Ni)	1.6.19	1, 20, 34, 38, 41, 47
20. HH	(24–27 Cr; 11–14 Ni)	1.6.20	1, 20, 34, 38, 41, 47, 99
21. HI	(26–30 Cr; 13–17 Ni)	1.6.21	20, 38, 41, 47
22. HK	(24–27 Cr; 18–22 Ni)	1.6.22	1, 20, 38, 41, 47, 99
23. HL	(28–32 Cr; 18–22 Ni)	1.6.23	20, 38, 41, 47
24. HN	(19–23 Cr; 23–27 Ni)	1.6.24	20, 38, 41, 47
25. HT	(13–17 Cr; 33–37 Ni)	1.6.25	1, 20, 38, 41, 47
26. HU	(17–21 Cr; 37–41 Ni)	1.6.26	20, 38, 41, 47
27. HW	(10–14 Cr; 58–62 Ni)	1.6.27	1, 20, 38, 41, 47
28. HX	(15–19 Cr; 64–68 Ni)	1.6.28	20,38, 41, 47
7. Other ferrous alloys		1.7	20, 24, 120
2. Aluminum and aluminum alloys			
1. 1100 (99.0 min. Al)		2.1	7, 15, 83, 109, 132
2. 1160 (99.6 Al)		2.2	15, 83, 109
3. 2024 (Al; 4.5 Cu; 1.5 Mg; 0.6 Mn)		2.3	15
4. 3003 (Al; 1.2 Mn)		2.4	7, 15, 109, 132
5. 3003 Alclad (3003 clad with Al-1 Zn)		2.5	7, 15, 109
6. 3004 (Al; 1.2 Mn; 1 Mg)		2.6	7, 15, 109
7. 3004 Alclad (3004 clad with Al-1 Zn)		2.7	7, 15
8. 5005 (Al; 1.2 Mg)		2.8	15
9. 5050 (Al; 1.3 Mg)		2.9	7, 15
10. 5052 (Al; 2.5 Mg; 0.25 Cr)		2.10	7, 15, 109
11. 5154 (Al; 3.5 Mg; 0.25 Cr)		2.11	7, 15, 109
12. 6061 (Al; 0.25 Cu; 0.6 Si; 0.25 Cr; 1.0 Mg)		2.12	7, 15, 109, 132
13. 6063 (Al; 0.6 Si; 0.7 Mg)		2.13	7, 15, 132
14. 43 (Al; 5 Si)		2.14	7, 15, 53
15. 214 (Al; 3.8 Mg)		2.15	7, 15
16. B214 (Al; 3.8 Mg; 1.8 Si)		2.16	7, 15
17. 356 (Al; 7 Si; 0.3 Mg)		2.17	7, 15, 53
18. Other aluminum alloys		2.18	15, 53, 109
3. Cobalt alloys			
1. Co-Cr-W alloys		3.1	68
2. Co-Cr-W-Ni alloys		3.2	68
3. Other cobalt alloys		3.3	
4. Copper and copper alloys			
1. Coppers			
1. Electrolytic tough pitch (99.9 plus Cu)		4.1.1	9, 15, 83, 109
2. Deoxidized (99.9 plus Cu)		4.1.2	9, 15, 17, 83, 103, 112, 132
3. Arsenical (99.4 plus Cu; 0.3 As)		4.1.3	9, 15, 17, 103, 112, 132
4. Other coppers		4.1.4	9, 15, 103
2. Cu-Zn alloys			
1. Admiralty	(70 Cu; 29 Zn; 1 Sn)	4.2.1	9, 15, 103, 112, 132
2. Admiralty, arsenical	(70 Cu; 29 Zn; 1 Sn; 0.04 As)	4.2.2	9, 15, 17, 103, 112, 132
3. Brass, aluminum	(76 Cu; 22 Zn; 2 Al)	4.2.3	9, 15, 17, 103, 110, 112, 132
4. Brass, cartridge	(70 Cu; 30 Zn)	4.2.4	9, 15, 17, 103
5. Brass, low zinc	(80 Cu; 20 Zn)	4.2.5	9, 15, 103
6. Brass, naval	(60 Cu; 39.25 Zn; 0.75 Sn)	4.2.6	9, 15, 93
7. Brass, red	(85 Cu; 15 Zn)	4.2.7	9, 15, 17, 103, 132
8. Brass, silicon red	(82 Cu; 17 Zn; 1 Si)	4.2.8	9, 15
9. Brass, yellow	(63–65 Cu; 35–37 Zn)	4.2.9	9, 15, 53, 103
10. Bronze, commercial	(90 Cu; 10 Zn)	4.2.10	9, 15, 103
11. Bronze, comm. hi-str.	(90.25 Cu; 6.9 Zn; 1.75 Pb; 1 Ni)	4.2.11	9, 15
12. Bronze, manganese	(59 Cu; 39 Zn; 0.7 Sn; 0.5 Mn; 0.8 Fe)	4.2.12	9, 11, 15, 53, 93
13. Munts metal	(60 Cu; 40 Zn)	4.2.13	9, 15, 17, 103, 112
14. Other Cu-Zn alloys		4.2.14	9, 15, 53, 93, 103, 112
3. Cu-Ni alloys			
1. Cupro-nickels	(60–90 Cu; 10–40 Ni)	4.3.1	9, 15, 17, 103, 112, 132
2. Nickel-silvers	(55–75 Cu; 10–20 Ni; 5–27 Zn)	4.3.2	9, 15
3. Other Cu-Ni alloys		4.3.3	9, 15, 103
4. Cu-Sn alloys			
1. Bronze, phosphor	(88–98.75 Cu; 1.25–10.5 Sn; P)	4.4.1	9, 15
2. Other Cu-Sn alloys		4.4.2	9, 15, 103
5. Cu-Al alloys			
1. Bronze, aluminum	(82–95 Cu; 5–10 Al)	4.5.1	9, 11, 15, 17, 53, 93, 103, 112
2. Bronze, al. silicon	(91–95.5 Cu; 3.5–7 Al; 1–2 Si)	4.5.2	15, 93
3. Other Cu-Al alloys		4.5.3	9, 11, 15, 53
6. Cu-Si alloys			
1. Bronze, silicon	(97–98.1 Cu; 1.9–3 Si)	4.6.1	15, 53, 83, 110
2. Other Cu-Si alloys		4.6.2	9, 15, 53
7. Cu-Be alloys		4.7	15
8. Other copper alloys		4.8	9, 15
5. Indium and indium alloys		5	15, 71
6. Lead and lead alloys			
1. Chemical lead	(99.9 min. Pb)	6.1	15, 53, 96, 98
2. Acid lead	(99.9 min. Pb)	6.2	15, 53, 98
3. Copper lead	(99.85 min. Pb)	6.3	15, 53, 60, 98

MATERIAL CLASSIFICATION	MAT'L. CODE	MANUFACTURERS' CODE NUMBERS
4. Antimonial (hard) lead (Pb; 1-12 Sb)	6.4	15, 53, 60, 96, 98
5. Tellurium lead (Chem. lead plus 0.04 Te)	6.5	15, 53, 96, 98
6. Other lead alloys	6.6	15, 53, 60, 96, 98
7. Nickel and nickel alloys		
1. Nickel	7.1	15, 47, 72, 83, 118
2. Ni-Cu alloys	7.2	15, 47, 72, 83, 118, 122
3. Ni-Cr alloys	7.3	15, 44, 47, 72, 83, 118, 122
4. Ni-Mn alloys	7.4	15, 122
5. Ni-Mo and Ni-Mo-Fe (Cr) alloys	7.5	15, 44, 47, 68, 118, 122
8. Noble metals and alloys		
1. Gold (99.9 plus Au)	8.1	60, 66
2. Palladium (99.9 plus Pd)	8.2	60
3. Platinum (99.9 plus Pt)	8.3	60
4. Rhodium (99.9 plus Rh)	8.4	
5. Silver (99.9 plus Ag)	8.5	60, 66
6. Other noble metals and alloys	8.6	
9. Tantalum (99.9 plus Ta)	9	52, 75
10. Titanium and titanium alloys		
1. Titanium (99 plus Ti)	10.1	13, 87, 108, 118, 120, 123
2. Ti-Cr alloys	10.2	120, 122
3. Ti-Mn alloys	10.3	122
4. Other titanium alloys	10.4	87, 120, 122
11. Zirconium (99 plus Zr-Hf)	11	23, 122, 123, 135
12. Other metals and alloys	12	68, 72, 122, 129

Non-metallic materials

13. Asbestos materials	13	57, 58, 111
14. Carbon and graphite materials		
1. Plain carbon	14.1	54, 64, 95, 114
2. Plain graphite	14.2	64, 95, 114
3. Impervious carbon (resin impregnated)	14.3	95, 114
4. Impervious graphite (resin impregnated)	14.4	51, 95, 114
15. Ceramic materials		
1. Glass	15.1	36
2. Fused silica	15.2	10, 54
3. Chemical porcelain	15.3	54, 78, 79, 82, 126
4. Stoneware	15.4	78, 126
5. Refractories	15.5	22, 35, 36, 48, 73, 74, 94, 117, 127
6. Other ceramic materials	15.6	22, 54, 73, 77, 100, 126
16. Plastic materials		
1. Phenolics	16.1	21, 43, 70, 85, 88, 90, 91, 101, 106, 124, 131
2. Ureas	16.2	
3. Melamines	16.3	
4. Polyesters	16.4	12, 26, 27, 43, 65, 91, 92, 106, 128
5. Epoxies	16.5	6, 21, 26, 30, 44, 56, 85, 91, 92, 131
6. Vinyls		
1. Polyvinyl chloride materials—Type I	16.6.1	5, 8, 12, 21, 25, 31, 46, 55, 61, 62, 67, 78, 86, 97, 107, 116, 126
2. Polyvinyl chloride materials—Type II	16.6.2	5, 8, 12, 25, 31, 46, 55, 61, 67, 97, 107, 116, 126
3. Polyvinylidene chloride	16.6.3	12, 61, 128
4. Other vinyls	16.6.4	6, 55, 90, 126
7. Acrylics	16.7	128
8. Polystyrenes	16.8	80, 128
9. Nylons	16.9	104, 128
10. Polyethylenes	16.10	2, 8, 42, 69, 80, 93, 97, 107, 113, 123, 128
11. Fluorocarbons		
1. Polytetrafluoroethylenes	16.11.1	28, 29, 33, 37, 40, 57, 104
2. Polytrifluorochloroethylenes	16.11.2	57, 76, 116
3. Other fluorocarbons	16.11.3	
12. Silicones	16.12	33
13. Cellulosics		
1. Cellulose nitrate	16.13.1	128
2. Cellulose acetate	16.13.2	128
3. Cellulose acetate-butyrate	16.13.3	107, 128
4. Cellulose ethers	16.13.4	
14. Other plastic materials	16.14	21, 56, 62, 69, 78, 86, 126
17. Rubber-like materials		
1. Natural rubber		
1. Hard	17.1.1	57, 58, 86, 105, 128
2. Soft	17.1.2	57, 58, 86, 105, 124, 128
2 Butadiene-styrene rubber	17.2	57, 58, 61, 62, 105, 128
3. Nitrile rubber	17.3	57, 58, 61, 62, 70, 86, 105, 128
4. Chloroprene rubber	17.4	21, 58, 101, 105, 128
5. Butyl rubber	17.5	50, 57, 58, 61, 105, 119, 128
6. Polysulfide rubber	17.6	58, 119, 128
7. Silicone rubber	17.7	39, 57, 58 128
8. Chlorosulfonated polyethylene	17.8	58, 128, 131
9. Other rubber-like materials	17.9	61, 65, 70, 76, 78, 128, 131
18. Wood	18	
19. Other non-metallic materials	19	63

Directory of Manufacturers of Construction Materials. Table II

To identify materials of various manufacturers listed here, see Table I, p. 197. (Note that some materials listed require further compounding before end use as equipment components, e. g., resin powders for plastic fabrication.)

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
1	Acco Casting Div., American Chain & Cable Co. Reading, Pa.	1.1.1, 1.1.2, 1.2.2, 1.4.1–1.4.6, 1.5.1–1.5.10, 1.5.12–1.5.14, 1.5.19, 1.5.20, 1.5.22, 1.5.25, 1.5.27		Castings	Pumps, valves, liquid handling equipment	
2	Acme-Fisher Div., Broadway Rubber Corp. Louisville, Ky.	16.10	Laybond	Sheet	Tank linings	Chlorosulfonated polyethylene
3	Alco Products, Inc. Schenectady, N. Y.	1.5.3	Hi-Qua-Loi	Forgings	Flanges, tube sheets, vessels, piping	
		1.3.4–1.3.6, 1.3.9		Forgings	Flanges, tube sheets, vessels, piping	
4	Allegheny Ludlum Steel Corp. Pittsburgh, Pa.	1.5.1–1.5.33	A-L	Bars, forgings, blocks, tubes, rods, wire, sheets, plates, strip	Heat exchanger tubing, towers, tanks, pipe	
		1.6.1–1.6.26	A-L	Castings	Fractionating tower sections, agitators, valve parts, pump parts, autoclaves, digesters, evaporators	
5	Alpha Plastics, Inc. Livingston, N. J.	16.6.1, 16.6.2	Alpha (101, 102, PE 150)	Tubular, bar rods	Pipe (sched. 40, 80, 120, pressure rated 150), fittings	
6	Aluminum of America Pittsburgh, Pa.	2.1, 2.4–2.7, 2.9–2.13		Various wrought	Tanks, vessels, shells, heat exchangers	
		2.14–2.17		Castings	Pump housings, impellers, fittings, agitators	
7	Amercoat Corp. South Gate, Calif.	16.6.4	Amer-Plate	Sheets	Tank linings	Plasticized
		16.6.4	Amercoat 23, 31, 55	Liquid	Tank linings	
		16.5	Amercoat 74	Liquid	Tank linings	Catalyzed
8	American Agile Corp. Bedford, Ohio	16.10	Agileno	Sheets, rods, tubes, pipe, heavy moldings, mattings, extrusions, blocks, foam, powder	Tanks, tank linings, ducting, valves and fittings, centrifugal fans, absorbers, tower packing, utility vessels	
		16.6.1	Agilide	Sheets, rods, pipe, tubes	Tanks, tank linings, ducting, valves, fittings, centrifugal fans, absorbers, handling equipment	
		16.6.2	Agilux	Sheets, rods, pipe, tubes	Tanks, tank linings, ducting, valves, fittings, blowers, absorbers, utility vessels	
		16.10	Agileno-HT	Sheets, rods, tubes, powder	Tank linings, tanks, utility vessels, valves and fittings, tower packing	High modulus linear polyethylene
9	American Brass Co. Waterbury, Conn.	4.1.1–4.1.4, 4.2.1, 4.2.2, 4.2.4, 4.2.5, 4.2.8–4.2.14, 4.3.1–4.3.3, 4.4.1, 4.4.2, 4.5	Anaconda	Various wrought	Stills, evaporators, calandrias, vats	
		4.2.3	Ambraloy	Tubular	Condenser and heat exchanger tubes	
		4.5.1	Ambraloy	Sheets, plates, rods, bars, wire, tubular, forgings	Piping, tube sheets, pump and valve components, vessels	
		4.2.6		Rods, forgings		Tobin bronze
		4.2.7		Sheets, plates, rods, bars, tubular	Piping, condenser and heat exchanger tubing, pump liners	85 red brass
		4.5.3	Tempaloy	Rods	Shafting	
		4.6.2	Everdur	Sheets, plates, rods, bars, wire, tubular, forgings	Stills, evaporators, calandrias	
10	Amersil Co. Hillside, N. J.	15.2	Amersil	Tubular, rods, sheets, plates	Pipe (B & S) and fittings, pots, crucibles, trays, muffles, tubing	Opaque and transparent
		15.2	Rotosil	Tubular	Tubes, pipe (conical, flanged, welded) and fittings, crucibles, pots	
		15.2	Optosil	Plates, ingots	Sight ports	
11	Ampco Metal, Inc. Milwaukee, Wis.	4.5.1	Ampco Metal, Ampcoloy	Sheets, plates, rods, bars, tubular, wire, forgings, castings, extrusions	Pump components, valve components, vessels, heat exchanger tubing, pipe and fittings, dynamite mixers, paper mill rolls	
		4.5.3		Rods, bars, wire, tubular, forgings, castings		
		4.2.12		Castings, forgings, extrusions		
12	Atlas Mineral Products Co. Mertztown, Pa.	16.6.1	Ampcoflex	Sheets, pipe	Tanks, ductwork, process piping	
		16.6.2	Pee Vee Cee	Sheets, pipe	Tanks, ductwork, process piping	
		16.6.3	Ampcolite	Pipe	Process piping	
		16.4	Plastaloy	Sheets, pipe	Tanks, ductwork, process piping	
13	Babcock & Wilcox Co., Tubular Products Div. Beaver Falls, Pa.	1.4.4, 1.5.3–1.5.12, 1.5.14–1.5.31	B & W Croloy	Pipe, tubing, welding fittings	Piping systems, condenser tubing, heat exchanger tubing, heater tubing, evaporator tubing	
		1.4.1	B & W Carbon Moly	Pipe, tubing, welding fittings		
		1.4.2	B & W Nicloy	Pipe, tubing, welding fittings		
		1.1.7	B & W Globeiron	Pipe, tubing, welding fittings		
		16.1	B & W A-40, A-50, A-70	Pipe, tubing	Heat exchanger tubing, piping systems	

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
14	Bart Manufacturing Corp. Belleville, N. J.	1.3.4	Bart Lectro-Clad	Sheets, plates, pipe, tubing, fittings	Heat exchanger tubing, vessels (all types)	
15	Belmont Smelting & Refining Works, Inc. Brooklyn, N. Y.	2.1–2.18, 4.1.1–4.1.4, 4.2.1–4.2.14, 4.3.1–4.3.3, 4.4.1, 4.4.2, 4.5.1–4.5.3, 4.6.1, 4.6.2, 4.7, 4.8, 5, 6.1–6.6, 7.1–7.5	Belmont	Slabs, bars	Vessels	
16	J. Bishop & Co. Platinum Works Malvern, Pa.	1.5.5, 1.5.6, 1.5.9, 1.5.10, 1.5.14, 1.5.15, 1.5.17–1.5.19, 1.5.21, 1.5.24, 1.5.25, 1.5.31		Tubular	Condensers, heat exchangers, piping	
17	Bridgeport Brass Co. Bridgeport, Conn.	4.2.2, 4.2.3, 4.2.4, 4.3.1, 4.1.2, 4.1.3		Tubular	Evaporator condensers, hydrogen coolers, steam condensers, turbine oil coolers, exhaust gas water heaters	
		4.5.1	Duronze IV	Tubular		
		4.2.13		Tubular		
		4.2.7		Tubular	Evaporator tubes, vent condensers, water heaters	
18	Brown Fintube Co. Elyria, Ohio			Tubular	Hairpin heat exchangers, tank heaters, line and suction heaters, inter- and aftercoolers, fired heaters	Finned tubing
19	A. M. Byers Co. Pittsburgh, Pa.	1.1.7		Tubular, bars, plates	Pipe, tanks, vats	
20	Calorizing Co. Wilkinsburg, Pa.	1.6.1–1.6.28, 1.7	Calite	Castings	Refining tube supports and heater components, radiant tube heating elements, centrifugal cast retorts, crusher parts	
21	Carboline Co. St. Louis, Mo.	16.6.1	Polyclads	Liquid	Tank linings	
		16.14	B Resin	Liquid	Tank linings	
		16.1	Phenolines	Liquid	Tank linings	
		17.4	Neoprene 100	Liquid	Tank linings	
		16.14	Fluorline 100	Liquid	Tank linings	
		16.5	Epoxy Series	Liquid	Tank linings	
		16.14	Carbomastics	Liquid	Tank linings	
22	Carborundum Co., Refractories Div. Perth Amboy, N. J.	15.5	Monofrax	Blocks	Glass tanks (feeder channels, paving, port areas, shadow walls, superstructures), ball mill liners	Fused cast
		15.5	Mullfrax	Blocks, shapes	Electric furnace roofs, glass tank superstructures, high temp. furnace linings, combustion chamber linings	Bonded fused mullite
		15.5	Carbofrax	Brick, tile, special shapes	Retorts, muffles, hearths, heat exchanger tubing, coke chutes	Silicon carbide
		15.5	Alfrax	Bricks, shapes	Powder metallurgy furnaces, reverberatory furnace roofs, synthesis gas generators, chemical process kettle settings	Fused alumina
		15.5, 15.6	Refrax	Special shapes	Pump parts, impeller arms, blades and casings, spray nozzles, burner tips, thermocouple tubes	Silicon nitride-bonded silicon carbide
23	Carborundum Metals Co., Div. Carborundum Co. Akron, N. Y.	11		Sponge, ingots	Heat exchangers, anodizing tanks	
24	Carpenter Steel Co. Reading Pa.	1.5.2, 1.5.5, 1.5.6		Bars, wire, strip, billets	Tanks, evaporators, crystallizers, tower sections	
		1.5.4, 1.7		Bars, wire, billets	Valves, valve trim, pump shafts	1.7 (Type 303 Se stainless)
		1.5.14–1.5.16, 1.5.25, 1.7		Bars, wire, strip, billets	Tanks, evaporators, crystallizers, tower sections	1.7 (Type 443 stainless)
		1.5.17, 1.5.18, 1.7		Bars, wire, strip, billets	High temperature chemical process equipment	1.7 (Type 348 stainless)
		1.5.19		Bars, wire, strip, billets	Highly stressed parts	
		1.5.21, 1.5.22		Bars, wire, strip, billets	Valve parts	
		1.5.23	Carpenter Stainless	Bars, wire, billets	Shafts, valve trim, other valve parts	
		1.5.24, 1.7		Bars, wire, strip, billets	Needle valves, ball check valves	1.7 (Type 420 F stainless)
		1.5.28		Bars, wire, strip, billets	Valve parts	
		1.5.26, 1.5.30		Bars, wire, billets	Pump shafts, valve parts	
		1.5.30, 1.7		Bars, wire, billets	Needle valves, ball check valves	1.7 (Type 440 F stainless)
		1.7		Bars, wire, strip, billets	Valves, valve fittings, pump parts, piping	Type 329 stainless
		1.7		Bars, wire, strip, billets	Agitating equipment, centrifugal pumps, pump shafts, valve stems, pickling racks, valve parts	20 alloy
		1.7		Tubing, pipe, sheets, plates, strip, bars, billets, wire	Mixing tanks, process piping, bubble caps, spray pickling equipment	20-Cb alloy
25	Carpenter Steel Co., Alloy Tube Div. Union, N. J.	1.5.12	Carpenter 20-Cb	Tubing, pipe, sheets, plates, bars, wire, billet, strip	Heat exchanger tubing, piping systems	19-21 Cr; 24-30 Ni; 2-3 Mo; 3-4 Cu
		1.5.31	Carpenter 7-Mo	Tubing, pipe		26.5-28.0 Cr; 3.75-4.50 Ni; 0.08 max. C; 1.25-1.75 Mo
		1.5.10	Carpenter 309-Cb	Tubing, pipe		

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
25	(continued)	1.5.16	Carpenter 317 L	Tubing, pipe		
		1.5.18	Carpenter 348	Tubing, pipe		
		1.5.31	Carpenter 442	Tubing, pipe		18-23 Cr; 0.15 max. C
		1.5.31	Carpenter 443	Tubing, pipe	Heat exchanger tubing, piping systems	18-23 Cr; 0.12 max. C; 0.9-1.25 Cu
		1.1.7	Carpenter Alloy B	Tubing, pipe		26-30 Mo
		1.1.7	Carpenter Alloy C	Tubing, pipe		14-16 Cr; 15-17 Mo
		16.6.1	Carpenter PVC #1	Pipe, tubing, fittings	Piping systems	
		16.6.2	Carpenter PVC #2	Pipe, tubing, fittings	Piping systems	
26	Celloste Co., Inc. Cleveland, Ohio	16.4	Cellcrete, Cerocrete	Liquid	Tank linings for concrete tanks	3-component mastic
		16.5	Cerofine	Liquid	Tank linings for concrete and steel tanks	3-component mastic
		16.5	Cerocrete "A"	Liquid	Tank linings for concrete and steel tanks	3-component mastic
		16.4	Polycor	Laminated shapes	Fume ducts, hoods, tanks	
27	Celanese Corp of America, Plastics Div. Newark, N. J.	16.4	Marco	Liquid	Linings, tanks, pipe	
28	Chemical and Power Products, Inc. New York, N. Y.	16.11.1	Chempro	Sheets, rods, cylinders, tubing, bars, tape	Packing, gaskets, mechanical seals, linings, expansion joints, special parts	
29	Chicago Gasket Co. Chicago, Ill.	16.11.1	Kerda	Rods, sheets, tubing, cylinders, tape	Gaskets, packings, seals	
30	Ciba Co., Plastics Div. New York, N. Y.	16.5	Araldite	Liquid	Pump impellers and casings	Casting resins
31	Colonial Plastics Mfg. Co. Cleveland, Ohio	16.6.1, 16.6.2	Van-Cor	Pipe tube, rods, sheets, extrusions, moldings	Piping systems, tanks, tank linings, ductwork, hoods, valves	
32	Colorado Fuel & Iron Corp. Wilmington, Del.	1.2.1, 1.3.9, 1.4.1, 1.4.2, 1.4.4, 1.4.6	C F & I	Plates	Tanks, pressure vessels, heat exchangers	
		1.3.4	C F & I Lectro-Clad	Plates, sheets		Bart process
33	Connecticut Hard Rubber Co. New Haven, Conn.	16.12	Colrlastic	Sheets, sponge, moldings, extrusions, fabrications	High temperature gasketing, seals	
		16.11.1	Temp-r-tape	Tape	Sealing, facing (on frangible disks)	
34	Cooper Alloy Foundry Corp. Hillside, N. J.	1.6.1–1.6.14, 1.6.16–1.6.20	C A	Castings	Fractionating tower sections, agitators, valve parts, pump parts, autoclaves, digesters, evaporators	
35	Corhart Refractories Co. Louisville, Ky.	15.5	Corhart Electrocast (Standard, Zac, 104)	Bricks, blocks, special castings	Furnace linings	
36	Corning Glass Works Corning, N. Y.	15.1	Pyrex Brand	Tubing, sheets, plates, rods, molded and blown shapes	Process piping, heat exchangers, columns, sight glasses, coolers	
		15.1	Vycor Brand	Tubing, sheets, plates, rods, molded and blown shapes	Sight glasses, calcining trays	96% silica
		15.5	Corning Brand	Blocks, tubes, cylinders, special shapes	High temperature melting units	
37	Crane Packing Co. Morton Grove, Ill.	16.11.1	Chemlon	Sheets, rods, tubing, tape	Pump and valve packings, mechanical seals, expansion joints, bellows and bellows type connectors, gaskets, hydraulic cylinder packing, "O" rings	
38	Crucible Steel Co. of America Pittsburgh, Pa.	1.6.1–1.6.23	Accumet	Precision castings	Pump casings, valve bodies, agitator blades, evaporator bodies	Wax injection
		1.6.1–1.6.28	Crucast	Castings	Valve trim and bodies, agitator blades	Sand castings
		1.5.1–1.5.33	Resistal	Strip, sheets, plates, rods, bars, wire	Pump casings, valve trim, valve bodies, agitator blades, tank linings, ball mill liners, evaporator bodies, heat exchanger tubing	
39	Dow Corning Corp. Midland, Mich.	17.7	Silastic	Unvulcanized stocks and pastes	Gaskets, seals, O-rings, ducts	
		17.7	RTV Silastic	Two-component, unvulcanized stocks	Gaskets, seals, O-rings, ducts	Room temp. vulcanizing
40	E. I. du Pont de Nemours & Co. Wilmington, Del.	16.11.1	Teflon		Packings, seals, gaskets	
41	Duraloy Co. Scottdale, Pa.	1.6.1–1.6.28	Duraloy	Castings	Pump casings, impeller glands, casing rings, heat exchanger tubes, pump liners, impeller shaft liners	
42	Durethene Corp. Chicago, Ill.	16.10	Durethene	Tubular	Pipe	
43	Durez Plastics Div., Hooker Electrochemical Co. N. Tonawanda, N. Y.	16.1	Durez	Granules	Valves, impellers, pump parts, rayon machinery parts	
		16.4	Hetron	Liquid	Ductwork, tanks	Flame-resistant
44	Duriron Co. Dayton, Ohio	1.1.3	Duriron	Castings	Centrifugal pumps, valves (plug, Y, diaphragm), fans, heat exchangers, ejectors, drain pipe, tank outlets, tower sections	
		1.1.3	Durichlor	Castings	Centrifugal pumps, valves (plug, Y diaphragm), fans, ejectors, drains, outlets	

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
44 (Continued)		1.6.14	Durimet 20	Castings	Centrifugal pumps, valves (plug, Y,) fans, jets, tank outlets, filter and cooler parts, special castings	
		7.5	Chlorimet 2, Chlorimet 3	Castings	Centrifugal pumps, valves (plug, Y), tank outlets, mixing nozzles, special castings	
		7.3	Durco D-10	Castings	Centrifugal pumps, Y valves	Ni-Cr-Fe-Cu-Mo alloy
		1.6.6	Durco 18-8-S	Castings	Special castings	
		1.6.10	Durco 18-8-S-Mo	Castings	Centrifugal pumps, valves (plug, Y), filter and cooler parts	
		1.6.12	Durco 25-12-S, 25-12-S-Mo	Castings	Special castings	0.07 max. C (CH-10 alloy)
		1.6.1	Durco D-12	Castings	Special castings	
		16.5	Durcon 2	Castings	Centrifugal pumps, valves (Y, diaphragm), exhaust fans, heat exchangers, special cast items	
45	Eastern Stainless Steel Corp. Baltimore Md.	1.3.9, 1.5.1, 1.5.2, 1.5.4–1.5.8, 1.5.10, 1.5.12–1.5.18, 1.5.21, 1.5.25		Sheets, plates	Autoclave bodies, evaporator bodies, stills, acid receivers, tank linings, absorption towers, tanks, chutes, conveyors	
46	Easton Plastic Products Co., Inc. New York, N. Y.	16.6.1, 16.6.2	Easton	Tubular	Piping systems	
47	Electric Steel Foundry Co. Portland, Ore.	1.1.2, 1.2.2, 1.4.1–1.4.6, 1.6.1–1.6.28, 7.1–7.3, 7.5	Esco	Castings	Pump impellers, pump casings, valve bodies, agitator blades, fittings, valve parts, pulp digester strainers, piping	
48	Electro Refractories & Abrasives Corp. Buffalo, N. Y.	15.5	Kellogg AA	Bricks	Furnace linings	Silicon carbide
		15.5	Tercod	Tile	Furnace linings	Silicon carbide
		15.5	Kellundite	Brick, tile	Furnace linings	Fused alumina
49	Empire Steel Castings, Inc. Reading, Pa.	1.2.2	ISO (1, 1A, 1B, 2, 2A, 2B)	Castings	Impellers, pump casings, valve bodies and trim	Higher C for increased strength and mild abrasion properties
		1.4.1	ISO-4	Castings	Valve bodies and trim	Strength at elev. temps.
		1.4.2	ISO-6A	Castings	Valve bodies, valve trim, pumps	High impact at low temp.
		1.4.6	ISO-7	Castings	Ball mill liners, crusher rolls, mixing blades	Abrasion resistant
		1.4.4	ISO-8	Castings	Valve bodies and trim, pumps	
		1.4.4	ISO-8A	Castings	Valve bodies and trim, pumps, crusher rolls	Hi-strength, abrasion resistance
		1.4.4	ISO-8B	Castings	Valve bodies and trim, pumps	Strength at elev. temps.
		1.4.4	ISO-8S	Castings	Valve bodies and trim, pumps, evaporator bodies	Strength at elev. temps.
		1.4.6	ISO-9A	Castings	Screw conveyors, liners, crusher rolls	High-strength
50	Enjay Co. New York, N. Y.	17.5			Chemical hose, conveyor belts, gaskets, seals, O-rings, linings	
51	Falls Industries, Inc. Solon, Ohio	14.4	Impervite	Sheets, plates, rods, bars, tube block	Heat exchangers (tubes, plates, cylinders, domes, shells), towers, pumps (seals, volute case assemblies, impellers), pipe, fittings, valves, plate heaters, cascade coolers, rupture disks	
52	Fansteel Metallurgical Corp. North Chicago, Ill.	9		Sheets, bars, rods, wire, tubular	Bayonet heaters, condensers, heat exchangers, coils, evaporators, feed lines, fittings, spargers	
53	Federated Metals Div., American Smelting and Refining Co. New York, N. Y.	2.14, 2.17, 2.18, 4.2.9, 4.2.12, 4.2.14, 4.5.1, 4.5.3, 4.6.1, 4.6.2		Ingots	Valves, fittings	
		6.1–6.6		Sheets, pipe, fittings, special shapes	Tank linings, heating and cooling coils, valves	
54	Filtros Inc. East Rochester, N. Y.	14.1, 15.2, 15.3, 15.6	Filtros	Plates, cylinders, porous disks	Nutsche type filters; air and liquid filter units; gas dispersion, fluidization and air conveying equipment; diffuser media; porcelain diaphragms for electrolytic cells; catalyst carrier	Quarts, carbon, fused alumina, mullite
55	Firestone Plastics Co. Pottstown, Pa.	16.6.1, 166.2, 16.6.4	Exon	Sheets, plates, rods, castings	Valve bodies, tank linings, gaskets	
56	Furane Plastics, Inc. Los Angeles, Calif.	16.14	Jet-Kote	Liquid	Linings for fume ducts, filter presses	Baked furane
		16.[illegible]	Epocast	Liquid	Linings for tanks, agitators	
57	Garlock Packing Co Palmyra, N. Y.	13	Garlock	Sheets, braided and woven forms	Gaskets, pump and valve packings	
		16.11.1	Garlock	Rods, sheets, sleeves, tape, tubing, custom molded and machine parts	Valve disks, pump and valve packings, diaphragms, impellers, liners, gaskets	
		16.11.2	Garlock	Rods, sheets, sleeves	Diaphragms, valve packings, valve disks and seats, tank linings, gaskets	
		17.1.1, 17.1.2, 17.2, 17.3, 17.5, 17.7	Garlock	Sheets, molded parts, tubing	Gaskets, other sealing applications	
58	General Rubber Corp. Tenafly, N. J.	13	Genbestos	Sheets	Gaskets	
		17.1.1, 17.1.2, 17.2–17.9		Sheets	Linings for tanks, valves	

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
59	Glascote Products, Inc. (Subsidiary A. O. Smith Corp.) Cleveland, Ohio	1.3.2	Glascote	Tubular	Piping systems	
60	Goldsmith Bros. Smelting & Refining Co. Chicago, Ill.	6.6	G. B.	Pigs	Tank linings, filter press linings, trays	Refined soft lead
		6.3, 6.4	G. B.	Pigs	Tank linings, filter press linings, trays	
		8.1, 8.2, 8.3	G. B.	Wire, sheets, foil	Vessels	Alloys also manufactured
		8.5	G. B.	Wire, rods, sheets, foil	Impeller blades, pipe, tank linings	Alloys also manufactured
61	B. F. Goodrich Chemical Co. Cleveland, Ohio	16.6.1	Geon	Powder	Pipe, tubing, valves, pipe fittings, gaskets, fume ducts, tanks	
		16.6.2	Geon	Cubes		
		16.6.3	Geon	Powder, cubes		
		17.3	Hycar	Slabs, powder	Gaskets, O-rings, pump parts, tubing, packings	
		17.3	Hycar	Slabs, powder, crumbs		
		17.5	Hycar	Slabs		
		17.9	Hycar	Slabs		Polyacrylic
62	Goodyear Tire & Rubber Co. Akron, Ohio	16.6.1	Pliovic	Powder	Gaskets, hose, tubing	
		16.14	Plio-Tuf	Powder, granules	Liquid metering end for chemical pumps, pipe, pump glands, pipe fittings	High-impact styrene
		17.2	Plioflex	Bales	Gaskets	
		17.3	Chemigum	Bales	Gaskets	
63	Graphite Specialties Corp. Niagara Falls, N. Y.	19	Graphitite	Rods, bars, tubes	Nozzles, crucibles, inserts, atomic pile moderator, piping, heat exchanger tubing	Impervious graphite, carbon-impregnated
64	Great Lakes Carbon Corp. Niagara Falls, N. Y.	14.1		Rods, bars, bricks, blocks, tubes	Tank linings, furnace linings, electrolytic cells	
		14.2		Rods, bars, bricks, blocks, tubes	Tank linings, furnace linings, nuclear reactors, electrolytic cells	
65	Greer Industries, Inc. Jamaica, N. Y.	16.4, 17.9	Diagrin	Moldings	Diaphragms, accumulator bladders and bellows, seals (O-rings, etc.), gaskets, pump impellers, pump and valve packings, valve seats	Cross-linked diisocyanates modified polyesters
66	Handy & Harman New York, N. Y.	8.1, 8.5		Sheets, plates, bars, tubular, wire, castings	Pump impellers, valve bodies, agitator blades, tank linings, heat exchanger tubing	
67	H. N. Hartwell & Son, Inc. Boston, Mass.	16.6.1	Boltaron 6200	Tubular, sheets, blocks, bars	Piping systems, valves, tanks	
		16.6.2	Boltaron 7200	Tubular, sheets	Pipe, tank linings	
68	Haynes Stellite Co. Kokomo, Ind.	7.5	Hastelloy Alloy B	Sheets, plates, rods, bars, tubing, wire, forgings, castings	Pump impellers, pump casings, valve bodies, agitator blades, tank linings, heat exchanger tubes, screw conveyor flights, autoclave bodies	
		7.5	Hastelloy Alloy C	Sheets, plates, rods, bars, tubing, wire, forgings, castings		Ni, Cr, Mo, W
		12	Hastelloy Alloy D	Castings	Pump impellers, pump casings, valve bodies, agitator blades, screw conveyor flights	Ni, Si, Cu
		7.6	Hastelloy Alloy F	Sheets, plates, rods, bars, tubing, wire, forgings, castings	Same as for Hastelloy Alloys B and C	
		3.2	Haynes Alloy No. 25	Sheets, plates, rods, bars, tubing, wire, forgings		
		3.1	Haynes Stellite Alloys	Sheets, castings, forgings	Seal rings, knives, sleeves	
69	Hercules Powder Co. Wilmington, Del.	16.14	Fenton	Molding powder	Valves, tank lining, pipe, tubing, pumps	Pentaerythritol polymer
		16.10	Hi-fax	Molding powder	Pumps, tubing, sheets, pipe	Low-pressure polymer
70	Hermite & Chemical Co. Manitowoc, Wis.	16.1	Hermite M-66	Molding powders	Small pump parts	
		17.3	Hercerol N-40	Crepe	Tank linings, gaskets	Crepe is compounded
		17.9	RC-9	Liquid	Tank linings	Self-curing
71	Indium Corp. of America Utica, N. Y.	5		Solders	Pump surfaces	Also salts for plating
73	International Nickel Co. New York, N. Y.	7.1	Inco	Sheets, plates, rods, bars, tubular, wire, forgings, castings	Autoclaves, dryers, evaporators, piping	
		7.2	Monel		Stills, evaporators, fans, gas filters, strippers, screens, valve trim	"S" Monel—cast form
		7.3	Inconel		Evaporators, fermentation tanks, heaters, lined towers	
		12	Incoloy			Fe-Ni-Cr alloy
		13	Nionel			Ni-Fe-Cr alloy
73	Ironton Fire Brick Co. Ironton, Ohio	15.6	Paver	Block, brick, special shapes	Tanks, vats	Acid-proof
		15.5		Block, brick, special shapes	Furnaces	Fire clay
74	Kaiser Chemicals Div. Oakland, Calif.	15.5	Kaiser	Brick, ramming mixes, mortars	Linings for steel, glass, cement, copper, lead, lime, dolomite furnaces	Periclase (MgO), chromite
75	Kawecki Chemical Co. New York, N. Y.	9		Sheets, plates, rods, bars, wire	Tank linings, evaporator bodies, pump impellers	

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76	M. W. Kellogg Co. Jersey City, N. J.	16.11.2	Kel-F 270, 300, 500	Molding powder, sheets, rods, tubing, custom molded parts, cementable laminate	Tank linings, tubing, gaskets, valve diaphragms, pump impellers and casings, agitators, pipe and pipe fittings	
		17.9	Kel-F	Gum, latex, molded and extruded forms	Gaskets, hose, valve diaphragms, seals, O-rings	Chlorotrifluoroethylene–vinylidene fluoride copolymer
77	Kennametal Inc. Latrobe, Pa.	15.6	Kennametal	Rods, bars, tubes, disks, blocks, blanks, pressings (metal powder), extrusions, preformed shapes	Ball mill liners, grinding balls, crusher components, scraper blades, nozzles, high pressure vessels	Sintered carbides
		15.6	Kentanium		Nozzles, wear strips, ball check valves, scraper blades, pump impellers	Sintered carbide for use at 1,800 F. and up
78	Maurice A. Knight Akron, Ohio	15.3, 15.4	Knight-Ware	Cast, molded, extruded	Pipe and fittings, valves, towers, tower packings, tanks	
		16.6.1	Saran	Sheets	Tank linings	
		17.9	Pyroflex	Sheets	Tank linings	
		16.14	Permanite		Pipe, towers, valve bodies, tanks	Carbon-filled furan resin reinforced with glass cloth
79	Knox Porcelain Corp. Knoxville, Tenn.	15.3	Knox	Raschig rings, other rings, Berl saddles	Tower packings	
80	Koppers Co. Pittsburgh, Pa.	16.8	Dylan	Molding powder	Pipe fittings	
		16.10	Dylan	Molding powder	Pipe	
81	Kutztown Foundry & Machine Corp. Kutztown, Pa.	1.1.1		Castings	Pump casings, evaporator bodies, heat exchanger and condenser water boxes, pots, kettles, valve bodies, autoclave bodies	
		1.1.2		Castings		
		1.1.4		Castings		
82	Lapp Insulator Co. Le Roy, N. Y.	15.3		Castings, special shapes	Pipe, valves, fittings, Raschig rings	
83	Leader Iron Works Inc. Decatur, Ill.	1.2.1, 1.3.4–1.3.6, 1.3.9, 1.5.5, 1.5.6, 1.5.14–1.5.18, 2.1, 2.2, 4.1.1, 4.1.2, 4.6.1, 7.1–7.3		Plates, sheets	Tank linings, evaporator bodies, autoclave bodies, heat exchangers, fractionating column shells and trays	
84	Link-Belt Co. Chicago, Ill.	1.1.7	Pruma	Castings	Conveyor and drive chain links, rocker arms, other conveyor parts	Pearlitic malleable iron
85	Lithcote Corp. Melrose Park, Ill.	16.1	LC-24, 19, 73	Liquid	Tank linings	
		16.5	LC-34, 610	Liquid	Tank linings	
86	Luzerne Rubber Co. Trenton, N. J.	16.6.1	Luzerne PVC	Extrusions, moldings, fabricated parts	Pipe, fittings, tubing	Rigid PVC, normal and high impact
		16.14	Luzerne	Extrusions, molded parts	Pipe, tubing	Rubber-resin compounds
		17.1.1	Luzerne Std., #56	Extrusions, molded parts, sheets, rods, tubes	Pipe and fittings, valves, pumps, linings	
		17.1.2	Luzerne	Sheets, molded parts	Linings, roll coverings	
		17.3	Luzerne Heat Resistant	Extrusions, sheets, rods, tubes, molded parts	Pipe and fittings, valves, pumps	
87	Mallory-Sharon Titanium Corp. Niles, Ohio	10.1	MST Grade III	Sheets, bars, billets, plates, strips, wire	Food kettles, baffles, nozzles, valve trim, heat exchanger tubing, agitator blades, anodizing equipment	Commercially pure
		10.4	MST 6 Al-4 V	Sheets, bars, billets, plates, strips, wire		6 Al; 4 V; bal. Ti
88	Marblette Corp. Long Island City, N. Y.	16.1	Marblette	Liquid	Tank linings	
89	McLouth Steel Corp. Detroit, Mich.	1.5.1		Sheets, strips	Beer fermenters	
		1.5.2		Sheets, strips	Strainers, screw conveyors	
		1.5.5		Sheets, strips	Heat exchangers, vats	
		1.5.6, 1.5.15		Sheets, strips	Large-section welded tanks	
		1.5.7		Sheets, strips	Impellers	
		1.5.14		Sheets, strips	Heat exchangers	
		1.5.17, 1.5.18		Sheets, strips	Burner parts	
		1.5.21		Sheets, strips	Fractionating tower shelves and bubble caps	
90	Metal & Thermit Corp. Rahway, N. J.	16.1	Unichrome B-124	Liquid	Tank linings	Haksi
		16.6.4	Unichrome 5300, 4000	Liquid	Tank linings	Plastisol
		16.6.4	Unichrome XL 2356	Liquid	Tank linings	
91	Minnesota Mining & Mfg. Co. Detroit Mich.	16.1, 16.4, 16.5	Scotchply	Rolls, sheets	Tanks	Uncured
		16.5	"3M" Brand	Tubular	Pipe, tubing	Reinforced
92	Modular Plastic Corp. Detroit, Mich.	16.4, 16.5	Polyglas	Sheets, castings, tubular, moldings	Tanks, tank linings, pipe, ducting, absorption towers and scrubbers	Fiber-reinforced, also bonded to steel
93	Mueller Brass Co. Port Huron, Mich.	4.2.6	Alloy 203	Forgings, rods	Valve bodies	
		4.5.1	Alloy 224 E	Forgings, rods	Valve seat inserts, valve stems	
		4.5.2	Alloy 802	Forgings, rods	Valve stems and seats, chlorine valve bodies	
		4.2.14	Alloy 600	Forgings, rods	Pump shafts	For severe loads
		4.2.12	Alloy 721	Forgings, rods	Rotors, pump parts, valve stems	2.5 Fe; 4 Al; 4 Mn
		16.10		Tubing	Liquid food handling	Black

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
94	Mullite Refractories Co. Shelton, Conn.	15.5	Shamva	Mixes, bricks, special shapes	Tower packing, tank lining, furnace lining	
95	National Carbon Co., Div. Union Carbide & Carbon Corp. New York, N. Y.	14.1	National	Plates, rods, bars, tubes, brick	Tank and vessel linings, Raschig rings, electrostatic precipitator tubes and parts, furnace linings, burners and hydrators	
		14.2	National	Plates, rods, bars, tubes, brick	Electrolytic cell anodes, bubble caps and trays, HCl combustion chambers, burners and hydrators, vessel linings and internals, cathodic protection anodes, nuclear reactor components	
		14.1, 14.2	National	Porous plates, rods, tubes	Filter tubes and plates, gas diffusion apparatus	
		14.3	Karbate	Plates, rods, bars, tubes, brick, rings	Tank and vessel linings, seal rings, piping, tower packing and internals	
		14.4	Karbate	Plates, rods, bars, tubes, brick, rings	Shell and tube heat exchangers, centrifugal pumps, pipe and fittings (armored and un-armored), valves, immersion-type heat exchangers, cascade coolers, HCl absorption equipment, towers, steam jets and ejectors	
96	National Lead Co. New York, N. Y.	1.3.3, 6.1, 6.4, 6.5, 6.6		Sheets, plates, tubular	Tank linings, piping, valve bodies, pump impellers, heat exchanger tubing, evaporator bodies, autoclave bodies, agitator blades	
97	National Tube Div., U. S. Steel Corp. Pittsburgh, Pa.	1.2.1, 1.4.1–1.4.6, 1.5.5, 1.5.14, 1.5.16–1.5.18	USS National	Tubular	Condenser and heat exchanger tubes, still tubes, superheater tubes	
		1.2.1, 1.4.1–1.4.6, 1.5.2, 1.5.4–1.5.8, 1.5.11, 1.5.14, 1.5.15, 1.5.17–1.5.23, 1.5.25, 16.6.1, 16.6.2, 16.10	USS National	Tubular	Pipe	
98	Northwest Lead Co. Seattle, Wash.	6.1–6.6	Bunker Hill	Sheets, bars, tubing, wire, castings, bricks,	Agitator blades, tank linings, tanks, piping	
99	Pacific Foundry Co., Ltd. San Francisco, Calif.	1.1.2	Ni-Resist	Castings	Pump and valve parts	Austenitic Ni or Ni-Cu iron, 20% plus alloy content
		1.1.3	Corrosiron	Castings	Pumps, valves, fans, pipe, fittings	
		1.6.6, 1.6.7, 1.6.10, 1.6.12, 1.6.20, 1.6.22		Castings	Pump parts, valves, agitators, autoclaves, digesters, evaporators	
100	Patterson Foundry & Machine Co. East Liverpool, Ohio	15.6	Porox	Blocks, balls	Ball mill linings, grinding media, tank linings	
		15.6	Arkite	Blocks, balls	Ball mill linings, grinding media (high density)	
101	Pennsylvania Salt Manufacturing Co. Philadelphia, Pa.	16.1	Pennalt MS-1, MS-13	Liquid	Pump impellers, pump casings, valve bodies	Furfural ketone casting resin
		17.4	Neo Line	Liquid solution	Tank linings	
		17.4	Neo Putty	Putty	Tank linings	
102	Pfaudler Co. Rochester, N. Y.	1.3.2		Tubular	Pipe, fittings	
103	Phelps Dodge Copper Products Corp. New York, N. Y.	4.1.1–4.1.4, 4.2.1–4.2.5, 4.2.7, 4.2.9, 4.2.10, 4.2.13, 4.2.14, 4.3.1, 4.3.3, 4.4.2, 4.5.1		Tubular	Heat exchanger tubing	
104	Polymer Corp. of Penna. Reading, Pa.	16.9	Polypenco	Rods, bars, strips, tubing, plates, slabs	Valve seats, gaskets, conveyor strips, wear strips	
		16.11.1	Polypenco	Rods, bars, tape, sheets, tubing, plates, slabs	Packings, seals, gaskets	
105	Quaker Pioneer Rubber Mills, Div. H. K. Porter Co. Pittsburgh, Calif.	17.1.1, 17.1.2, 17.2, 17.3, 17.4, 17.5	Metabond	Sheet rubber bonded to metal by vulcanization	Pump impellers, pump casings, agitator blades, tank linings, screw conveyor flights, rolls, pipe and pipe fittings	
106	Reichhold Chemicals, Inc. White Plains, N. Y.	16.4	Polylite	Liquid	Tanks, vats, tank linings, conveyor buckets, ducts, piping	
		16.1	Plyophen	Liquid	Plating barrels, bubble caps	
107	Resin Industries Sub. The Borden Co. Santa Barbara, Calif.	16.6.1, 16.6.2, 16.10, 16.13.3	Resinite	Tubular	Pipe	
108	Rem-Cru Titanium, Inc. Midland, Pa.	10.1	Rem-Cru A-40	Sheets, plates, bars, billets, wire, tubing, strips	Linings, agitators, autoclaves, valve bodies, anodizing racks, filters	Min. yield str. 40,000 psi.
		10.1	Rem-Cru A-55	Sheets, plates, bars, billets, wire, tubing, strips	Heat exchangers, tubing, linings, autoclaves, agitators, anodizing racks	Min. yield str. 55,000 psi.
		10.1	Rem-Cru A-70	Sheets, plates, bars, billets, wire, tubing, strips	Linings, anodizing racks, fittings, valve bodies, centrifuges	Min. yield str. 70,000 psi.
109	Reynolds Metals Co. Louisville, Ky.	2.1, 2.3		Sheets, plates, wire, rods, bars	Brewery kettles, tanks, food equipment	
		2.4, 2.5		Sheets, plates, rods, bars, tubular	Heat exchanger tubing, process piping, jacketing, bubble caps	

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
109	(continued)	2.6		Sheets, plates	Baffle plates, tank heads	
		2.10		Sheets, plates, wire, rods, bars	Tanks, exchanger shells	
		2.11		Sheets, plates	Tanks, exchanger shells	
		2.12		Sheets, plates, wire, rods, bars, tubular	Piping, heat exchanger tubing, tube sheets, tank shells	
		2.18		Plates, sheets	Hydrogen peroxide process equipment	Types 5254, 5652
110	Revere Copper & Brass, Inc. New York, N. Y.	4.2.3	Revlon	Tubular	Heat exchanger tubing	
		4.6.1	Herculoy	Sheets, plates, rods, bars, tubular	Stills, evaporators, calandrias, tanks, mixers	
111	Ruberoid Co. New York, N. Y.	13	Ruberoid	Fiber	Gaskets, pipe	Pipe: asbestos-cement
112	Scovill Manufacturing Co. Waterbury, Conn.	4.2.1–4.2.3, 4.2.12, 4.3.1, 4.5.1		Tubular	Heat exchanger tubes	
		4.2.14		Tubular	Heat exchanger tubes	70 Cu; 29 Zn; 1 Sn; 0.04 P
		4.1.2, 4.1.3		Tubular	Heat exchanger tubes, piping	
113	Spencer Chemical Co. Kansas City, Mo.	16.10	Poly-Eth	Cubes, powder	Pipe, tubing, tank linings, impeller linings	
114	Stackpole Carbon Co. St. Mary's, Pa.	14.1–14.4		Plates, rods, tubular	Electrolytic cells	
115	Standard Tube Co. Detroit, Mich.	1.5.1, 1.5.2, 1.5.5–1.5.7, 1.5.9–1.5.12, 1.5.14–1.5.18		Tubular	Pipe, tubing	
116	Stokes Molded Products Trenton, N. J.	16.6.1, 16.6.2, 16.11.2		Moldings	Pipe fittings, pumps and valves (parts and assemblies)	
117	Chas. Taylor Sons Co. Cincinnati, Ohio	15.5	Tasil, Tamax	Brick, special shapes, castables, ramming mixes	Glass tanks, metallurgical furnace linings, heating and heat treating furnaces, carbon reactors, air heaters	Sillimanite (mullite)
		15.5	Tamul	Brick, special shapes, castables, ramming mixes		Synthetic mullite
		15.5	Tayeor	Brick, special shapes, castables, ramming mixes	Heating furnaces, rotary kilns, metallurgical furnace linings, crucibles, carbon reactors	Alumina
		15.5	Zircon	Brick, special shapes, castables, ramming mixes	Glass tanks, phosphate furnaces, aluminum melting furnaces, frit smelters, metal melting furnaces, sulfur burners	Zirconium silicate
118	Techalloy Co. Rahns, Pa.	1.5.2, 1.5.5–1.5.9, 1.5.11, 1.5.13–1.5.18, 1.5.25, 7.1–7.3, 7.5, 10.1	Techalloy	Wire, rods, strips	Valve trim, filter screens	
119	Thiokol Chemical Corp. Trenton, N. J.	17.5	Thiokol	Sheets	Gaskets	
		17.6	Thiokol	Sheets	Gaskets, tank linings	
120	Timken Roller Bearing Co. Canton, Ohio	1.4.1	Silmo	Tubes, bars	Heat exchanger tubing	1.50 Si; 0.50 Mo; 0.15 C
		1.4.4	DM	Tubes, bars	Heat exchanger tubing, valve bodies	1.25 Cr; 0.75 Si; 0.50 Mo; 0.15 C
		1.4.4	DM-2	Tubes, bars	Heat exchanger tubing, valve bodies	1.00 Cr; 0.30 Si; 0.50 Mo; 0.15 C
		1.4.4	Sicromo	Tubes, bars	Heat exchanger tubing	Cr (3–9); Si; Mo; 0.15 C
		1.4.6	"17–22 A" S	Tubes, bars	Heat exchanger tubing	1.25 Cr; 0.65 Si; 0.50 Mo; 0.25 V; 0.30 C
		1.5.5, 1.5.10, 1.5.12, 1.5.14, 1.5.17, 1.5.18, 1.5.19, 1.5.21		Tubes, bars	Heat exchanger tubing, valve bodies	
		1.7	16–25–6	Bars	Pickling chains	16 Cr; 25 Ni; 6 Mo
121	Titanium Metals Corp. of America New York, N. Y.	10.1	Ti–55A, Ti–65A, Ti–75A, Ti–100A	Sheets, plates, rods, bars, tubes, wire, forgings, extrusions	Autoclaves, linings, impellers, heat exchangers, valves, leaching tanks, heating elements	
		10.2	Ti-140A	Sheets, rods, bars, wire, extrusions		
		10.2	Ti-155A	Rods, bars, wire, extrusions		
		10.4	Ti-6 Al-4 V	Sheets, plates, rods, bars, wire		
122	Trent Tube Co. East Troy, Wis.	1.4.2–1.4.6, 1.5.1–1.5.5, 1.5.9–1.5.11, 1.5.13, 1.5.14, 1.5.16–1.5.18, 1.5.20, 1.5.25, 1.5.31, 7.2–7.5, 10.1–10.4, 11, 12	Contour, Trentweld	Tubular	Piping systems	
123	U. S. Industrial Chemicals Co. Div. National Distillers Products Corp. New York, N. Y.	11		Sponge	Heat exchangers, anodising tanks	
		16.10	Petrothene	Granules	Pipe, tanks	
124	U. S. Rubber Co. New York, N. Y.	17.1.2	U. S. Permbond	Moldings	Linings for vacuum crystallisers, steel pipe and fittings, tanks, fans, scrubbers	

MFR. CODE	MANUFACTURER	MATERIAL CODE	TRADE NAME OF MATERIAL	FORMS AVAILABLE	APPLICATIONS IN PROCESSING EQUIPMENT	REMARKS
124 (continued)		16.1	Uscolite	Tubular	Pipe, fittings, valves	
		17.1.2		Tubular	Chemical hose	
125	U. S. Steel Corp. Pittsburgh, Pa.	1.5.1–1.5.33	USS Stainless	All commercial forms	Pressure vessels, tubing, heat exchangers, valves, tank linings, impeller blades	
		1.4.1–1.4.6	Carilloy	All commercial forms	Valves, tanks	
		1.4.1–1.4.6	USS T-1	Plates	Pressure vessels, chutes	High-yield (90,000 psi. min.)
		1.4.6	USS Cor-ten, USS Man-ten, USS Tri-ten	All commercial forms	Applications requiring high strength and light weight	Low-alloy, high strength steel
		1.4.5	USS A-R	Plates	Chutes	Abrasion-resisting steel
126	U. S. Stoneware Co. Akron, Ohio	16.6.1, 16.6.2, 16.6.4	Tygon	Sheets, rods, tubular	Linings, tubing, gasketing, rings	
		15.3, 15.4		Cast, molded, extruded	Tower sections, tower packings, vessels, pipe fittings, filters, and filter plates, valve bodies	
		15.6	Alite	Molded, extruded	Seals, pump plungers	Sintered metallic oxides
		16.14	Duralon	Cast	Filter plates, valve bodies	Furan resin
		16.6.4	Tygoflex	Liquid	Linings, gaskets	
127	Universal Atlas Cement Co. New York, N. Y.	15.5	Lumnite	Powder, castable mixes	Furnace linings	Calcium aluminate
128	Vulcanized Rubber & Plastics Co., Inc. Morrisville, Pa.	16.4, 16.7, 16.8, 16.9, 16.10, 16.13.1–3–3		Moldings	Impellers, casings, blades, couplings, fittings	Glass-fiber reinforced (polyesters)
		16.6.3		Moldings	Impellers, blades	
		17.1.1–17.9		Moldings	Impellers, casings, linings, blades, tubing	
129	Wall Colmonoy Corp. Detroit, Mich.	12	Colmonoy Nos. 4, 5, 6, 70	Rods castings, powders	Valve trim, pump parts, agitator parts	Hard-facing alloys
		12	Colmonoy No. 20, Wallex Nos. 1, 6	Rods, castings	Valve trim, pump parts, agitator parts	Hard-facing alloys
		12	Colmonoy No. 1	Electrodes	Crusher rolls, screw conveyor flights	Hard-facing alloy
130	Wallingford Steel Co. Wallingford, Conn.	1.5.1, 1.5.2, 1.5.5–1.5.7, 1.5.9–1.5.11, 1.5.14–1.5.18, 1.5.21, 1.5.22, 1.5.25		Welded tubing, strips	Heat exchanger tubing, condenser tubing, evaporator tubing, process piping, reactor tubing	
131	Wisconsin Protective Coating Co. Green Bay, Wis.	16.1, 16.5	Plasite 7100, 7122, 7155, 7111	Liquid	Tank linings	
		16.5, 17.9	Plasite 7133	Liquid	Tank linings	
		16.1	Plasite 3055, 1060	Liquid	Tank linings	
		17.8, 16.1	Plasite 7190, 7195	Liquid	Tank linings	
		16.1, 17.9	Plasite 7145	Liquid	Tank linings	
132	Wolverine Tube Div. of Calumet & Hecla, Inc. Detroit, Mich.	1.2.1, 2.1, 4.1.2, 4.1.3, 4.2.1–4.2.3, 4.3.1	Wolverine Trufin	Tubular	Heat exchanger tubes	Integrally finned tubes
		Any combination of above	Bimetal Trufin	Tubular	Heat exchanger tubes	
		2.1, 2.4, 2.12, 2.13, 4.1.2, 4.1.3, 4.2.1–4.2.3, 4.2.7, 4.3.1		Tubular	Heat exchanger tubes	
		Any combination of above		Tubular	Heat exchanger tubes	Duplex condenser tube
133	Worthington Corp. Harrison, N. J.	1.5.14	Worthite	Bars wire, castings	Pumps, pump impellers, pump casings, valves, fittings, machined parts	
134	Youngstown Sheet & Tube Co. Youngstown, Ohio	1.4.6	Yoloy	Sheets, plates, bars, tubular	Tanks, piping, brine lines	1.50–2.00 Ni; 0.75–1.25 Cu
		1.4.6	Yoloy "E"	Sheets, plates, bars	Tanks	0.50–1.00 Ni; 0.25–0.50 Cu; 0.20–0.40 Cr
135	Zirconium Metals Corp. of America (National Lead Co. Subsidiary) New York, N. Y.	11		Sheets, plates, rods, bars, tubes, wire	Heat exchangers, anodising tanks	

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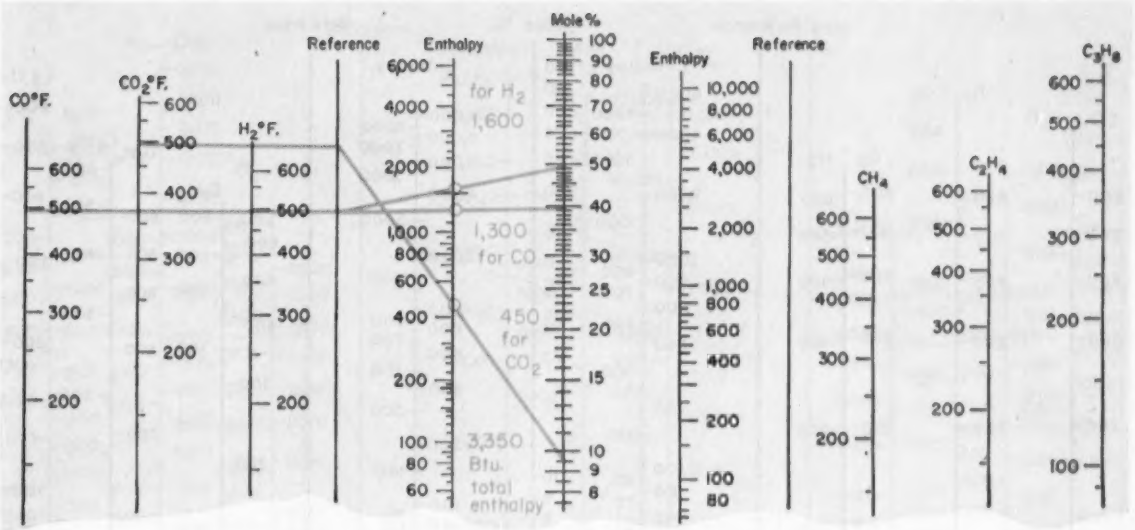


Charts Help Solve Heat Balances

All you need to find enthalpy of gas mixture are mole percent of constituent fractions and the temperature of the mixture. Pressure correction can be included.

A. H. YOUNGER, Pacific Petroleums, Ltd., Calgary, Alberta, Canada*

WHEN you design facilities to produce synthesis gas you must calculate several heat balances. On the following pages, 210 and 211, you will find two charts that should save you considerable calculating time.

These charts give you the lb. mole enthalpies for various gases commonly present in synthesis gas, at stream temperatures from 32 to 3,000 F.

How to Use Chart

Suppose that you wish to find the enthalpy of a gas containing 40 mole % CO, 50 mole % H_2 and 10 mole % CO_2 at 500 F.

First, you draw a line horizontally from the 500-F. point on the CO line to the reference line. At the reference line connect the end of the horizontal line with 40 on the mole-percent curve. Then, at the intersection of this line with the enthalpy line read off the partial enthalpy due to the presence of CO. This is equal to 1,300 Btu.

Repeat for H_2 and CO_2. The sum of partial enthalpies is 3,350 Btu./mole.

With these charts, the standard state (0 enthalpy) is taken as a gas at 1 atm. and 32 F. If the standard state of water is taken as a liquid at 32 F., you must add the heat of evaporation at 32 F., 19,360 Btu./lb. mole.

If water vapor is present, express it as mole % of the dry gas in the mixture. Where there is more than 1 mole of water per mole of dry gas, use 1/10 of the mole % of water when working the solution on the chart. Then, multiply the partial enthalpy result by a factor of 10.

Where less than 1% of a component is present, multiply the mole % by 10, find the partial enthalpy and divide this by 10 to get the correct value.

While the charts do not provide for the effect of pressure on enthalpy, you can calculate an approximate correction. First, calculate the pseudo critical temperature and pressure of the mixture. This equals the sum of the products of mole % multiplied by critical temperature for each gas fraction; and the sum of the products of mole % multiplied by critical pressure for each gas fraction.

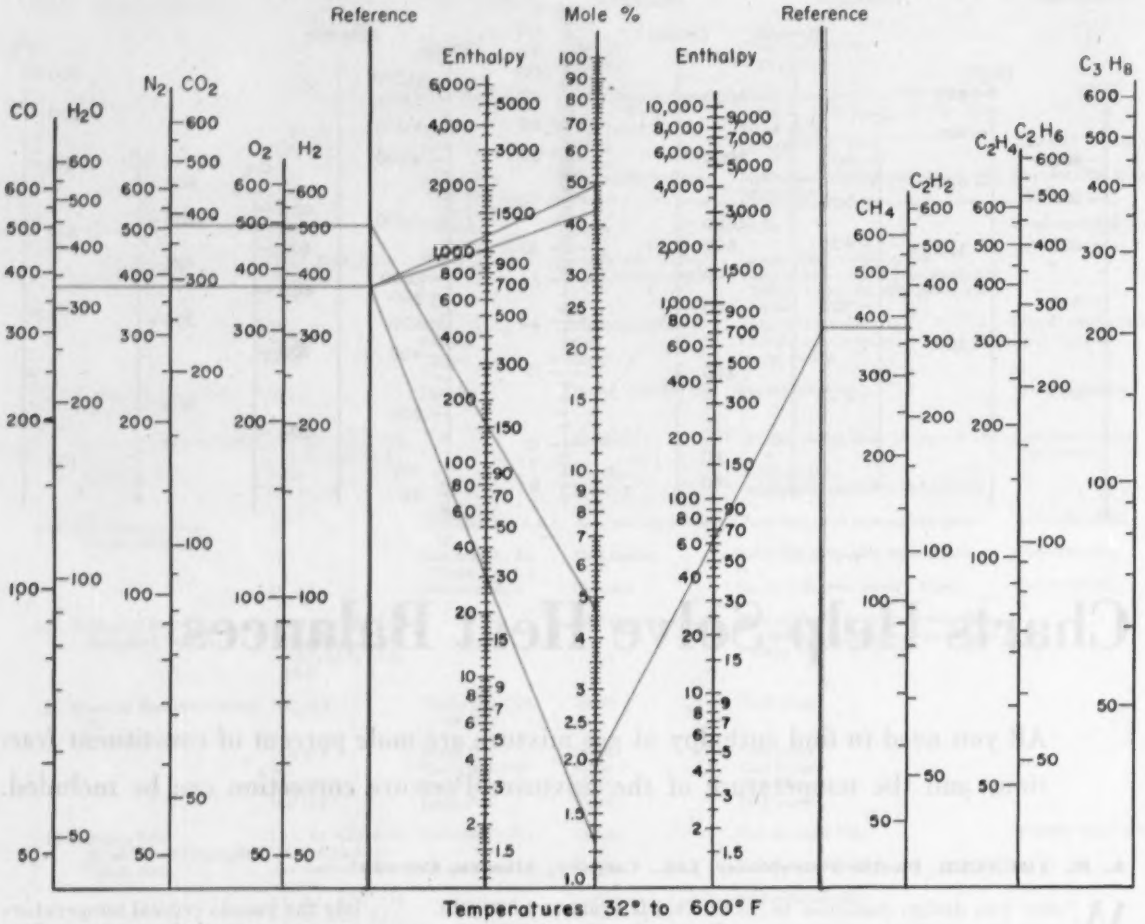
Actual temperature and pressure divided by the pseudo critical temperature and pressure of the mixture gives T_r and p_r, the reduced temperature and reduced pressure respectively.

Next, refer to chart in Hougen and Watson, Chemical Process Principles, Part II, p. 500 John Wiley, 1947. Using the values T_r and p_r calculated by method above, you find on the chart a correction factor for molal specific heat, c_p. Multiply this factor by the temperature difference between the actual temperature and 32 F. to get the enthalpy correction.

Turn the page and you will see how a synthesis gas problem is handled to allow correcting the enthalpy for pressure conditions.

*Meet your author on page 411.

Enthalpy Chart for Low Temperature Range



Problem Feed to the preheater of a CO converter is 1,262 moles of dry gas and 1,565 moles of steam per hr. at 380 F. and 400 psig. Molal composition of the dry gas is: CO, 49.7%; H_2, 44.2%; CO_2, 4.6%; N_2, 1.3%; CH_4, 0.2%.

Feed gas will be heated to 700 F. by discharge gas from the CO converter containing 1,815 moles of dry gas and 1,012 moles of steam per hr. at 850 F. and 370 psig. Molal composition of the dry gas in the converter discharge is: CO, 4%; H_2, 61.4%; CO_2, 33.2%; N_2, 1.2%; CH_4, 0.2%.

Find the duty of the exchanger and the outlet temperature of the cooling gases.

Solution Solution is based on bone dry gas. The charts above are used to determine enthalpy conditions for both gas streams. From the totals, corrected for pressure, are obtained the exchanger duty and outlet temperature of the gas being cooled.

The pressure correction is based on the critical temperature, deg. R., and critical pressure, psia., for each constituent.

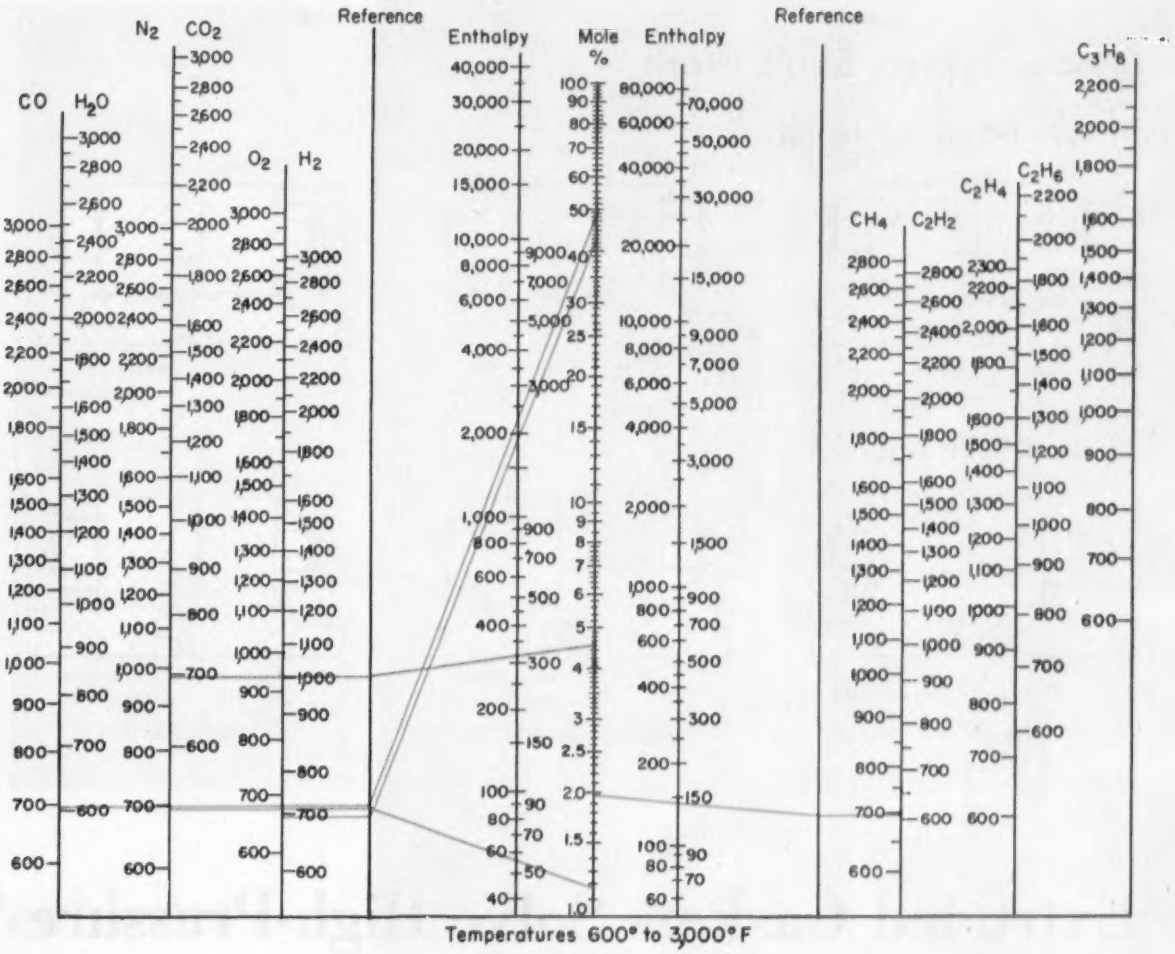
The absolute temperature and pressure of the gas stream are divided by the totals below to give reduced temperature, T_r, and reduced pressure, P_r. Thus, $T_r = 840/722 = 1.16$ and $1,160/722 = 1.61$; $P_r = 415/1,950 = 0.212$.

Using these values on Hougen and Watson's chart, referred to previously, we obtain a c_p correction factor of 1.0 which enables us to calculate an enthalpy correction, $1.0(380-32) = 348$ Btu. at 380 F. And for the enthalpy correction at 700 F. the c_p correction factor is 0.36; the enthalpy correction is $0.36(700-32) = 240$ Btu.

Enthalpy at 380 F., 6,009 Btu./mole, plus the correction factor, 348 Btu./mole, gives an adjusted total of 6,357 Btu./mole. Likewise, adjusted total at 700 F. is 12,034 Btu./mole.

Duty of the exchanger is $1,262(12,034-6,357) = 7,160,000$ Btu./hr.

Enthalpy Chart for High Temperature Range



By repeating the same procedure on the hot gas stream discharging from the CO converter we get for this stream an adjusted total enthalpy of 10,627 Btu./mole at 850 F.

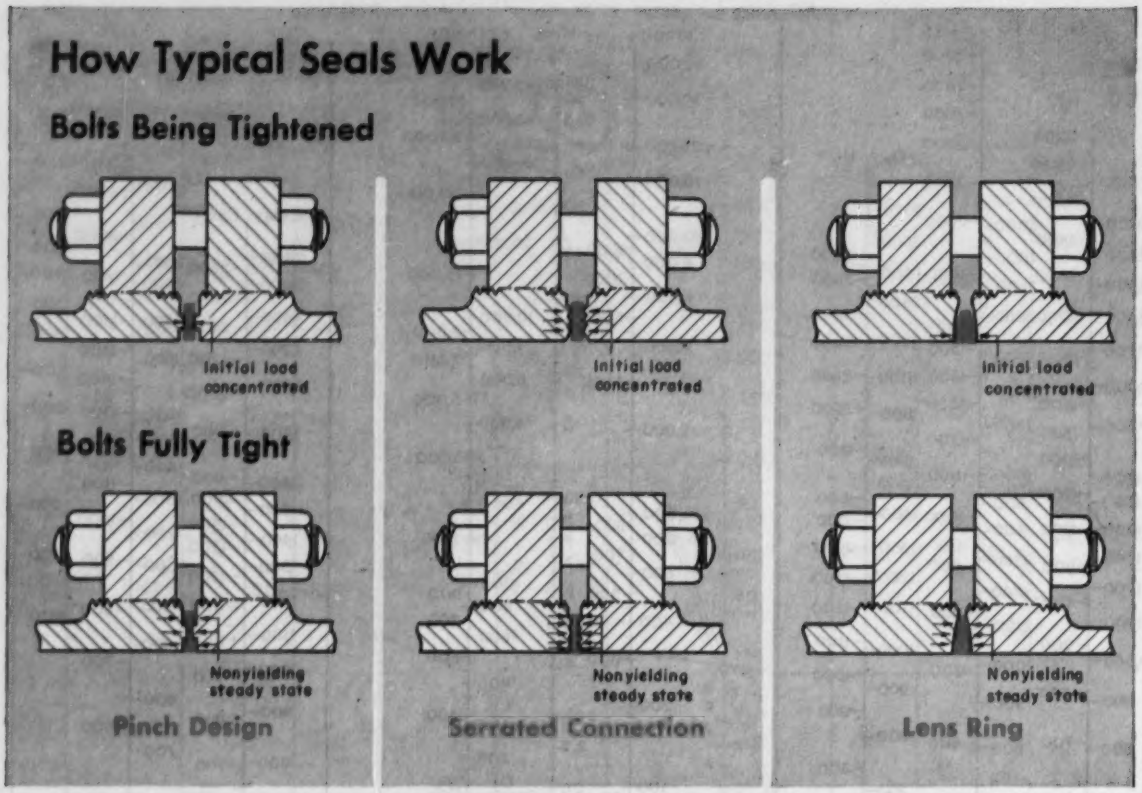
Leaving the exchanger this stream must have an enthalpy per mole equal to [1,815 (10,627)—7,160,000]/1,815 = 6,700 Btu.

By trial and error the discharge temperature with enthalpy closest to this value is 555 F. with 6,687 Btu./mole.

Although the pressure correction adds somewhat to the enthalpy of the gas it does not materially affect the estimated duty of the exchanger or temperature of outlet gas.

Enthalpies From Charts Are Corrected for Pressure With Pseudo Criticals

Feed Stream		Enthalpy		Pseudo Critical Temp. & Pressure			
Gas	Mole %	380 F.	700 F.	T_c	pT_c = (Mole %) (T_c)	P_c	pP_c = (Mole %) (P_c)
CO	49.7	1,210	2,400	242	120.0	514	255.0
H_2	44.2	1,100	2,000	60	26.5	188	83.0
CO_2	4.6	160	320	548	25.2	1,073	49.4
N_2	1.3	32	60	227	3.0	493	6.4
CH_4	0.2	7	14	343	0.2	693	1.4
H_2O	124.0	3,500	7,000	1,166	1,442.0	3,210	3,980.0
Total/2.24 moles					1,616.9		4,375.2
Total/mole		6,009	11,794		722.0		1,950.0



Extruded Gaskets Solve High-Pressure

Manufacturers can produce pipe or tube of any reasonable strength. But the problem has been to hook it tightly together at ultra-high pressures. Soft, fully-confined gaskets seem to be today's answer.

RAYMOND MEYER, The Griscom-Russell Co., Massillon, Ohio.*

With the use of higher and higher working pressures in many chemical processes and with the development of a number of new high-pressure processes, the design engineer has found himself severely limited by conventional gasketing designs.

For convenience in this article, let's pause right here to define what we mean by high pressure. Let's name pressures up to 1,000 psi. *high pressure*; up to 5,000 psi., *very-high pressure*; up to 10,000 psi., *quite-high pressure*; and over 10,000 psi., *ultra-high pressure*.

* Meet your author on p. 412

Gasketing in the pressure ranges from 100 psi. up has been in accordance with the time-proven "nonyielding" gasket principle.

PRINCIPLES OF GASKETING

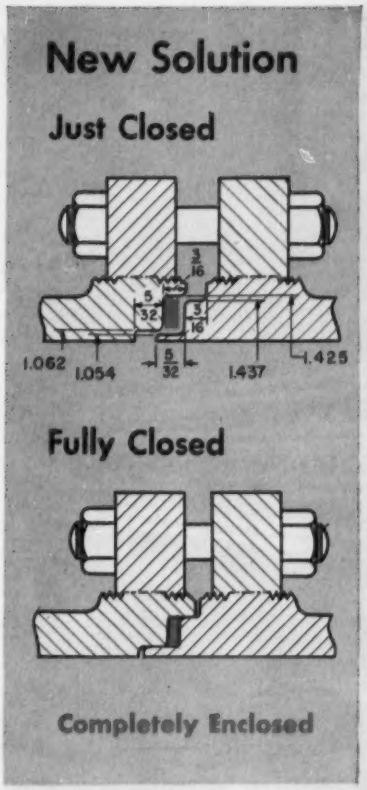
Designs call for a gasket whose surface will yield up to a certain specified point as the flange bolting is tightened. Then the gasket ceases to yield and without further crushing absorbs all the additional load that is placed on it by the flange.

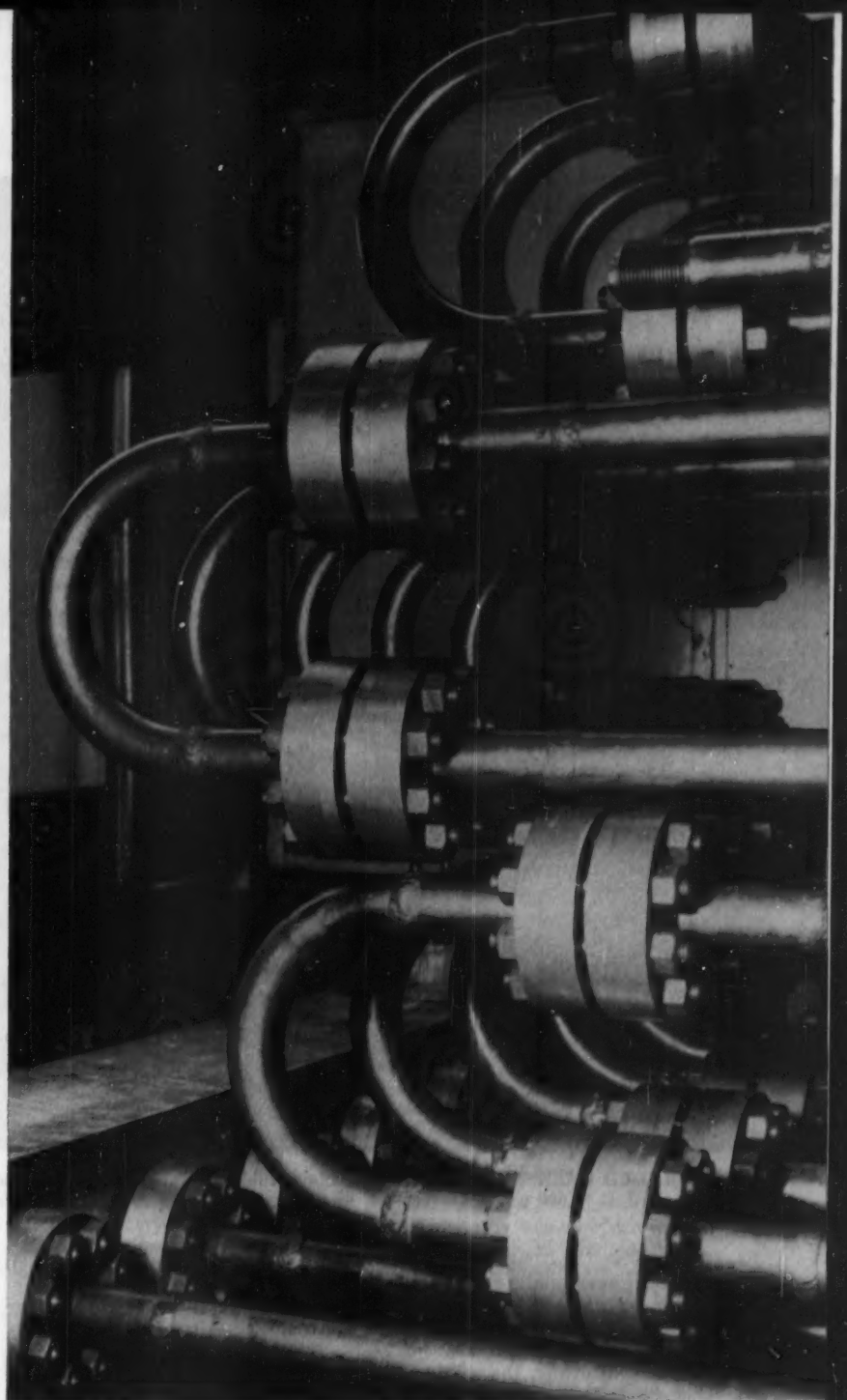
Of necessity, this design requires a flange face that is harder than the gasket. This is required to get the initial yield without deforming the flange surface.

IMPOSSIBLE HARDNESS

While this concept works fine in pressure ranges that approach 10,000 psi., the point is finally reached where the gasket must be so hard that it is impossible to get a harder flange. Also, the flange dimension becomes outlandishly cumbersome, when compared with the tube.

For example, a 1-in. tube designed for ultra-high pressures requires a flange that is 9¼-in. O.D., 4½-in. thick, with eight bolts each 1½-in. thick.





Problems

Sketches above illustrate some basic gasket designs where the nonyielding concept has been applied. These include methods that introduce temporary stress concentrations to produce short-term yield and result in a perfect seal.

Some of these gasket shapes use the internal pressure on the joint to aid in seating the gasket.

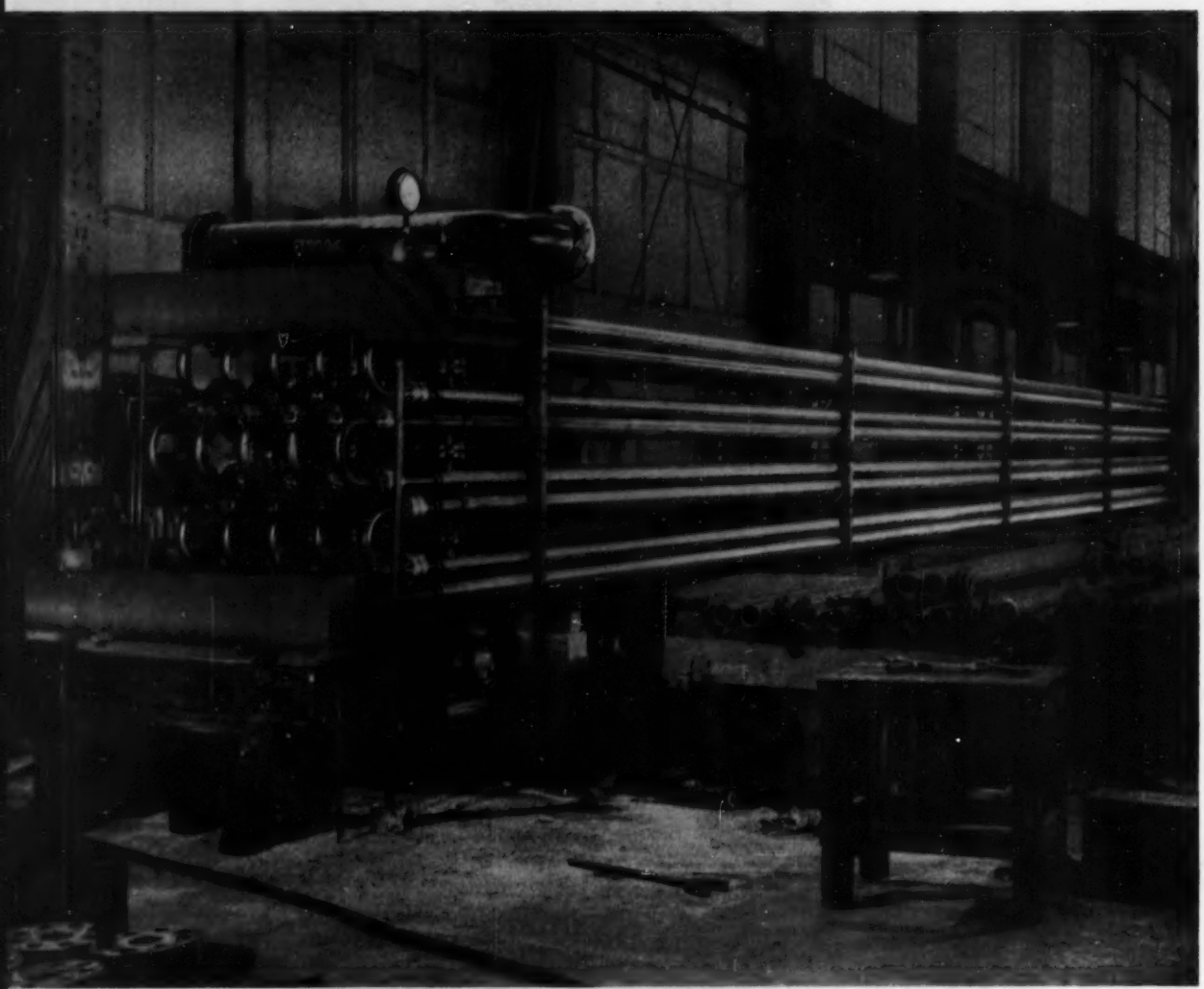
Analysis of the loads imposed on these flanging arrangements shows that the dimensions are dictated by two different loads: one necessary and the other the result of the nonyielding concept. These loads—which from the design standpoint are the influencing factors in determining flange dimensions—are the required load applied by flange bolting to resist internal pressure and the additional load applied by bolting to compress the gasket hard enough to seal the joint.

It is this latter, additional load that has prevented the use of nonyielding gaskets up in the ultra-high-pressure range. Pressures in this range will stress any gasket material well beyond its yield point.

HERE'S THE ANSWER

The answer lies in the use of soft, fully-confined gaskets. And these gaskets have radically-changed flange requirements. A flange using such a gasket and equivalent to the one we described above would be only 6¼-in. O.D., 1 15/16-in. thick, with eight bolts only ¾-in. thick. The photograph above shows a connection using these soft gaskets.

Here the flange is being used for its primary purpose: resisting the



EXTRUDED GASKETS SOLVED the sealing problem on these ammonia condensers designed to operate at 8,400 psi. and tested at 15,000 psi. Pipe sections, 60-ft. long, needed special freight cars for delivery to purchaser's plant site.

internal forces tending to push the joint apart.

The added load required to compress the gasket is almost insignificant. Naturally, the soft gasket must be fully confined to prevent leakage. As a consequence, radial dimensions must be held to plus or minus 0.002 in. But this is no problem with modern machine tools.

GASKET SEALS FLUID

Tolerances required for this soft-gasket design may be considered by some to be too exacting for usual field usage. But the fact remains that in the ultra-high-pressure range of 10,000 psi. and up, unusual conditions exist. Unusual care in manufacture is required.

With the gasket seat totally enclosed, there no longer is any relationship between gasket material and contained pressure. A soft aluminum, copper or rubber gasket can safely contain pressure in the ultra-high range. Here the gasket is performing its primary function of furnishing a fluid seal. It is not also adding to a large unnecessary flange loading. The flange designed to hold the longitudinal internal pressure will definitely compress the gasket (see last sketch, preceding page for the general arrangement).

TIGHTEN, CRUSH AND FILL

Exactly what happens when we bolt up this flange? First, we crush the gasket—it extrudes to fill every part of the confining space. We obtain truly perfect sealing, as all of the gasket material flows. Then, when the confining area is completely filled, the gasket resists further compression giving counterbalanced forces needed for a connection that will remain tight under field conditions.

This new idea in gasket design —a design that allows the gasket to contain the fluid and the bolting to resist the pressure—is the practice that will allow us to proceed into the ultra-high-pressure range.

Update Your Reactor Design Method

Chemical reactors, the nerve centers for today's plants and refineries, still evolve from tedious, expensive experimentation. This article—first of three—proposes an up-to-date direct approach.

JU CHIN CHU, Rohm & Haas Co., Huntsville, Ala.*

DESIGNING a chemical reactor, the engineer faces an entirely different problem than he does when he designs equipment for carrying out various unit operations such as distillation, heat exchange, extraction or fluid transport.

For example, there is an established procedure that can be used to design a fractional distillation column to its exact dimensions if vapor-liquid equilibrium data and plate efficiencies are available. In extreme cases, if the vapor-liquid equilibria data are reliable, no other data are required for the design. Various methods can be used to give estimated plate efficiencies and estimated thermal data.

Therefore, a crude tower for a multimillion-dollar petroleum refinery can be designed, built and installed without ever going through a pilot-plant stage. This crude tower—along with other distillation towers designed in the same manner—may represent up to 40% of the total investment in some refineries.

The same design story is generally true in the case of heat exchangers, condensers, storage tanks, absorbers, extractors, pumps and instruments. There is no need for a pilot plant before the design if equilibrium data and transfer coefficients are available.

Transfer coefficients of heat and mass have been correlated into generalized functions based on transport properties. Transport properties, such as diffusivity, viscosity and thermal conductivity are either available in the literature or can be estimated. Various methods for estimating engineering properties are accurate enough for design purposes.

Not So for Reactors

On the other hand, there is no generalized correlation that we can use today to predict the course and hourly yield of a reacting system.

Complex reactions under different conditions for a given system further complicate the situation. Sensational effects often occur.

Hydrogenation in vapor phase over a nickel catalyst may be decreased to one tenth by the presence of a trace of sulfur. Carbon monoxide, which reacts smoothly with pure cobalt to form cobalt carbonyl, will not react at all when a trace of oxygen appears.

For each reacting system, then, it is absolutely necessary that we have specific data on the rate of reaction and the reactions. But with specific data available and through the application of chemical kinetics, we can use a sound quantitative approach that leads to a satisfactory engineering design or the prediction of performance.

Reactor cost often represents a relatively high percentage of plant investment. For an ethylene oxide plant of economical size, the reactor itself accounts for about 40% of the total investment. In view of this high percentage of cost, there is no excuse for using any rule-of-thumb in conducting the reactor design.

Process Engineer's View

In the design of an efficient converter or reactor, the process engineer must find the answers to these questions:

- What size reactor will meet the specified rate of production at minimum cost?
- How can I remove or supply heat of reaction and still maintain an isothermal condition within the reactor?
- What control or instrumentation do I need when operating this reactor?
- What materials of construction can withstand the anticipated corrosion and erosion effects?

Answers to the last two questions necessarily require the services of specialists in the fields of instrumentation and materials of construction.

Chemical kinetics plays a major role in dictating the final answers to all of these questions.

Old Practice in Design

The old practice in designing a reactor is based mostly on tedious experimental work in which conversion reactions are studied in successively larger units.

When the performance of the reactors in two successive stages is identical, the jump to a final commercial size is considered a safe risk. The cost of stagewise pilot plants can be tremendous.

And after the work is all done we still know absolutely nothing about interactions among the various operating variables and how they affect yield. Any operational upset, any change in purity or feed composition, any increase or decrease in operating capacity can make the performance flexibility of the reactor a complete mystery.

It is impossible to find another set of optimum operating condi-

*Professor Chu of the Polytechnic Institute of Brooklyn carried out the work reported in this article while acting as a summertime consultant to the Rohm & Haas Co., Huntsville, Ala. Some of the subject matter in this article and the two parts that will follow is part of an unclassified report under Army Ordnance Corp. contract number W-01-021-ORD-324.

Meet your author on p. 410.

tions without additional tedious effort.

Erroneous Application

Early applications of chemical kinetics to reactor design failed to achieve their objectives.

Information from the laboratory was given in a number of graphs that showed the isolated effect of temperature, pressure, space velocity and reactant ratios on the yield of a specified product. This information, giving no quantitative interactions among various factors, has very limited value for the purpose of reactor design.

Each combination of operating variables imposes a different set of temperature and concentration distributions inside a reactor. Graphs of isolated data are specific for the experimental reactor at a fixed condition and are of no value to the process engineer for the design of a reactor that may be many times as large as the experimental one.

This is largely due to an improper experimental method and insufficient attention given to complete data correlations and the fundamental equations used for reactor design.

What Do We Need?

Before we discuss what information should be available for a reactor design, it may be desirable to survey the reactors that are now used commercially. Corrigan, Young and Mills have done such a survey recently in this magazine (*Chem. Eng.*, Sept. 1955, p. 204 and Oct. 1956, p. 211).

However, for our purposes in this article we can classify reactors as either homogeneous or heterogeneous; batchwise or flow. Flow reactors can have concurrent, countercurrent, mixed or partial flow.

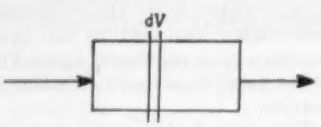
Whatever the type of reactor, it must be simple in mechanical design. This is essential for a low investment cost and a reasonable maintenance expense. To arrive at a simple mechanical design, we'll need to know much about what goes on inside the reactor.

Basic Design Equations

Let's look at the basic design equations for a common type of industrial reactor, the concurrent-flow reactor. Here all the flow is in one direction. The basic design equations are:

- A material balance across any differential section of the reactor, neglecting longitudinal mixing.
- The rate of conversion.
- An energy balance across the same differential section.
- A heat balance between the reacting system and the surrounding coolants or heating fluid.
- The pressure drop across the reactor.

Using the sketch below we can arrive at a material balance across the differential section dV. For a homogeneous reactor



$$F\,dX = R\,dV \qquad (1)$$

while for a catalytic reactor,

$$F\,dX = R\,dW \qquad (1a)$$

Most difficult equation to obtain is the rate of conversion, $R = dX \div d\theta$. Not only is it related by chemical reactions but also by some physical processes that accompany a chemical reaction.

In the case of a homogeneous reactor, the rate of conversion is affected by the chemical reaction rates and the rate of mixing. Where the rate of mixing is very high, chemical reactions control the overall rate of conversion.

In heterogeneous reactions there is mass transfer from one phase to

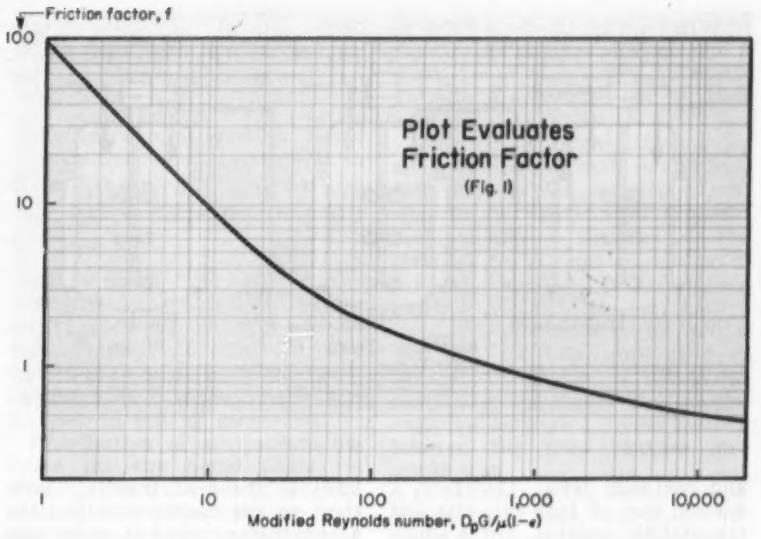
Nomenclature (Consistent Units)

a	Activity
A, B	Reactants
C_A, etc.	Concentration of component C, etc.
C_{A0}, etc.	Initial concentration of component A, etc.
C_M	Concentration of impurities
C_N	Concentration of inerts
C_p	Heat capacity of reacting system at constant pressure
C_p'	Heat capacity of heat transfer medium at constant pressure
d	Differential operator
D	Reactor diameter
D_p	Catalyst particle diameter
D, E	Products
f	Mathematical function of
f_o	Fouling factor on the heating-medium side
f_r	Fouling factor on the reactor side
F	Feed rate, mass per unit time
g_c	Gravitational constant
G	Mass velocity, mass per unit time per unit cross-sectional area
h	Heat transfer coefficient
h_o	Heat transfer coefficient on the side of the cooling or heating medium
h_r	Heat transfer coefficient on the reactor side
i	Subscript for the general case
k	Reaction rate coefficient
K	Chemical equilibrium constant
K_d, etc.	Distribution coefficient of compounds A, B, C, D, etc. between two liquids
l	Tube thickness
L	Length of reactor
m, n	Number of moles of reactants involved in a chemical reaction which determines the over-all rate of reaction
Mo	Molecular weight
N	Number of reactors in series
q, r	Number of moles of products involved in a chemical reaction which determines the over-all rate of reaction
q_{rT}	Heat of reaction per mole of a given product formed, at temperature T
R	Reaction rate, moles produced per unit volume per unit time
SQ_r	Heat released by the reaction in a differential section of the reactor
t	Initial temperature
T	Absolute temperature, final temperature
U	Over-all heat transfer coefficient
V	Volume
w	Mass of catalyst in reactor
W	Flow rate of reacting system
X	Conversion, moles of product formed per unit mass of feed
γ	Activity coefficient
ϵ	Voidage fraction of packed bed
θ	Reaction time
μ	Viscosity
π	Total pressure
ρ	Density

another. Mass transfer can be equally as important as chemical reaction in determining the rate of over-all conversion. For instance, in the catalytic transformation of a fluid reactant to a fluid product we find these distinctly separate steps:

- Mass transfer of reactants to and products from the catalyst particles.
- Diffusion of reactants and products within the pores of the catalyst particle.
- Activated adsorption of the reactants and desorption of the products.
- Reaction on the active centers of the catalyst surface.

The slowest step determines the over-all rate of conversion.



Conversion Correlations

On the basis of possible mechanisms or the rate-controlling step, kinetic equations are available to correlate a number of catalytic reactions. [2, 3]

Consider the case of a homogeneous reaction in a flow reactor. Assume that the chemical reaction controls the rate of over-all conversion. Further, let's assume for the purpose of illustration that this equation represents the reaction:

$$nA + mB = rE + qD \qquad (2)$$

Rate of conversion, R, which is the net rate between forward and backward reactions, is given by:

$$R = ka_A^n a_B^m - (k/K)a_E^r a_D^q \qquad (3)$$

where the a terms are the activities of various components in the reaction system.

Activity is a complex function of factors such as temperature, pressure, concentrations and impurities in the system. The equilibrium constant, K, and rate constant, k, are characteristics of the system and are functions of temperature.

If we sum up the exponents n, m, r *and* q in Eq. (3) we get the order of the reaction. However, we want to point out that the values of the exponents are not necessarily the same as in the stoichiometric equation of a chemical reaction. They are not necessarily constants for a given reacting system.

Industrial experience indicates that these exponents—when added together—are not necessarily integral numbers. Fractional and variable orders are possible. On occasion, even negative orders of reaction have been found in homogeneous reactions.[3] In the case of esterification, for example, the order of reaction can be a function of temperature, catalyst concentration, solvent concentration or conversion. And it is possible that pressure may be a variable.

Considering all these variables, we can use a generalized function to represent the rate of conversion in the case of a homogeneous reaction and where a single chemical reaction controls the over-all rate of reaction.

$$R = F(T, \pi, C_A, C_B, C_E, C_D, C_N, C_o, C_M, X) \qquad (4)$$

Concentrations of reactants C_A, C_B and of products C_E, C_D are related to the product converted per unit mass of feed. The stoichiometric ratio is given in the balanced Eq. (2) for the over-all chemical reaction.

If we use Mo for the molecular weight of the original feed, we can develop equations that relate the moles of various components flowing across any differential section of the reactor.

$$C_A = (FC_{AO}/Mo) - (FXa/e)$$
$$C_B = (FC_{BO}/Mo) - (Fxb/e)$$
$$C_E = FX$$
$$C_D = FXd/e$$
$$C_{inerts} = FC_{NO}/Mo$$
$$C_{impurities} = FC_{MO}/Mo$$

Total concentration =

$$FX\left(1 + \frac{d - a - b}{e}\right) + (F/Mo)(C_{AO} + C_{BO} + C_{NO} + C_{MO})$$

We'll assume that the amount of catalyst present is negligible. Then we can write expressions that represent the concentrations in mole fractions of various components at any section of the reactor.

$$C_E = FX/\phi \qquad (5a)$$
$$C_D = (FXd/e)/\phi \qquad (5b)$$
$$C_A = [(FC_{AO}/Mo) - (FXa/e)]/\phi \qquad (5c)$$
$$C_B = [(FC_{BO}/Mo) - (FXb/e)]/\phi \qquad (5d)$$
$$C_N = (FC_{NO}/Mo)/\phi \qquad (5e)$$
$$C_M = (FC_{MO}/Mo)/\phi \qquad (5f)$$

where in each case ϕ is an abbreviation for the following expression:

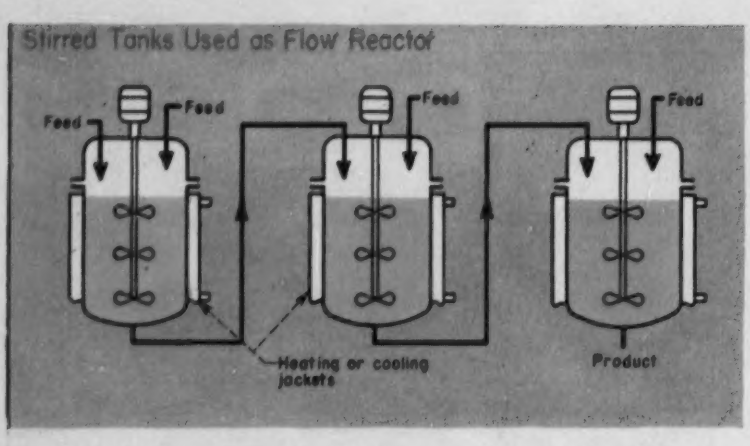
$$FX\left(1 + \frac{d - a - b}{e}\right) + (F/Mo)(C_{AO} + C_{BO} + C_{NO} + C_{MO})$$

If we have more than one rate-controlling chemical reaction in the same reacting system, the relation between various concentrations and conversions will become much more complicated.

In the case of a catalytic reaction, the rate of reaction also depends on the activity and the fouling of the catalyst. Various constants in a catalytic rate equation (for a solid catalyst) apply only to the catalyst for which they were evaluated. Any changes in catalytic activity will change these constants.

Where changes in activity are not great, including an activity factor in the over-all rate equation may be a reasonable and simple solution. Catalyst activity is probably a function of conversion and onstream time.

Fouling factor depends on the total pressure as well as conversion



and onstream time. Therefore, a general case of both catalytic and noncatalytic reaction, with a single chemical reaction as the rate-determining step, can be given as a mathematical function:

$$R = f(T, \pi, X, \theta, C_{AO}, C_{BO}, C_{NO}, C_{MO}, C_{CO}, F/Mo, a, b, c, d) \quad (6)$$

Should more than one chemical reaction affect the concentrations of various components in the reacting system, a kinetic rate equation must be established for each of these reactions. Then, material balance equations similar to Eqs. (5a) through (5f) must be established for each component taking into account all of the chemical reactions that form them and consume them. Certainly, this is a complicated mathematical procedure.

Balance the Energy

The third relationship that we need for a reactor design is an energy balance across the same differential section of the reactor:

$$SQ_r = wC_p\,dt + U\pi D(T - t)dL \quad (7)$$

Terms in Eq. (7) are identified in the table of nomenclature on p. 216. The equation is given for a reactor that has a circular section.

Heat released by a reaction, SQ, is related to the heat of reaction, q_{rT} and conversion, X, by:

$$SQ_r = q_{rT}(R\,dV)$$

or,

$$SQ_r = q_{rT}(R\,dw) \quad (8)$$

where q_{rT} is the heat of reaction based on the formation of one mole of the product at the temperature of the reactor section.

The over-all coefficient, U, is related to the heat transfer coefficient on the reactor side and the heat transfer coefficient on the side of the heat transfer medium as well as to the fouling factors by:

$$U = (1/h_r) + f_r + f_o + (D_r/k_M D_M) + (D_r/h_o D_o) \quad (9)$$

However, the fouling factor on the reactor side, f_r, cannot be treated as a constant. It varies with time and can be most nearly correlated by:

$$df_r/d\theta = f_o(X)^N \quad (10)$$

For a heterogeneous reactor that uses solid catalyst in a fixed bed, the calculation of f_r is rather uncertain. A local hot spot may result from the slow rate of heat transfer through the solid bed. Because of this difficulty and the desirability of maintaining an isothermal condition, the fluidized reactor is used whenever an exothermic reaction is conducted on a large scale.

Reported data for heat transfer coefficients in fluidized beds can be found in "Fluidization," edited by D. F. Othmer, Reinhold Publishing Corp., New York (1956). Extensive tables are given on pp. 34, 35, 42, 43 and 52.

Through the analogy of momentum, heat and mass transfer, we have developed a generalized correlation for the heat transfer coefficient between the surface of catalyst particles and a flowing fluid. When the modified Reynolds number is larger than 30,

$$(h/C_pG)(C_p\mu/k)^{0.667} = 1.77[D_pG/(\mu - \mu_c)]^{-0.44} \quad (11a)$$

When the modified Reynolds number is less than 30,

$$(h/C_pG)(C_p\mu/k)^{0.667} = 5.7[D_pG/(\mu - \mu_c)]^{-0.78} \quad (11b)$$

With the use of effective shape factors and Fig. 2-18 on p. 64 of "Fluidization," we can evaluate heat transfer coefficients for particles of irregular shape after we replace the mass transfer factor along the ordinate of the figure by heat transfer factor.

Thus, it's possible to calculate the temperature of the catalyst from the temperature of the reacting fluid. Since the life, activity and fouling factor of a catalyst depend on temperature, calculation of the heat transfer coefficient provides a quantitative bridge from activity and fouling factor of the catalyst to temperature of the reacting system.

Balance the Heat

As our fourth relationship for reactor design, we need a heat balance between the reacting system and the surrounding or immersed heat transfer mediums across the differential section of the reactor it is given by:

$$U\pi D(T - t)dL = w_c C_p'\,dt \pm \text{heat leakage} \quad (12)$$

Heat leakage represents the heat loss to the surroundings and carries a minus sign if the heating medium surrounds the reacting system. If a coolant is used, heat is gained from the surroundings and we use a plus sign. When we use coils inside our reactor, instead of an outside jacket, the heat leakage term disappears from Eq. (12).

Find Pressure Drop

The fifth and final relation that we need for our design is the pressure drop through the reactor. The reactor should be designed to give the minimum pressure drop. Calculating the pressure drop serves a dual purpose. It checks the allowable limit of pressure drop through the reactor and it helps to specify and size the pump ahead of the reactor.

Across any section of the reactor, the pressure drop is given by these equations:

$$-d\pi = 2f\frac{G^2(1 - \epsilon)dL}{g_o\rho\epsilon^3 D_p} \quad (13a)$$

$$-d\pi = 2f\frac{G^2 dL}{g_o\rho D} \quad (13b)$$

where Eq. (13a) can be used for packed beds; and Eq. (13b) can be used for homogeneous reactors.

The term f is a friction factor which has been found from a generalized function of Reynolds number. For a homogeneous reactor the correlation of friction factor and Reynolds number can be taken from standard texts and Perry's handbook. For a catalytic reactor —both fixed and fluidized beds— you can use Fig. 1 on p. 217. Here the friction factor is given as a function of the modified Reynolds number and the voidage fraction.

That's All We Need

We now have all the design equations that are required for the process design of a chemical reactor. For recapitulation, we have summarized these equations in the table on p. 220.

Such a set of equations can be solved simultaneously and integrated properly between the feed and effluent of a reactor to compute the volume required for a specified production rate under a variety of reaction conditions.

Note that we do need a kinetic equation to describe the reaction. This can be established by a systematic study and logical interpretation of experimental data.

Stirred Tank Reactors

Should we have the case of a stirred tank or a series of agitated reactors (see sketch on p. 218) with a continuously flowing reacting system, the design equations will be different for the material balance, energy balance and the pressure drop calculations. We can use the same kinetic equations, however. And the rate of reaction is always evaluated at the exit conditions of the reactor.

Of course, this is based on the assumption that sufficient agitation is created inside the tank or reactor, and that the temperature and composition of the effluent are identical with those of the reacting system inside the tank.

Material balance of the product across an nth agitated tank-type reactor in a series is given by:

$$F_{n-1}X_{n-1} = F_nX_n - RV \qquad (14)$$

where the subscript refers to the origin of the stream; R is the rate of conversion in lb.-moles of products per unit time per unit volume of the reactor; V is the volume of the reactor.

Consider the case of a nitration that is conducted in two liquid phases in an agitated tank. Assume that the reaction equation is

$$A + B \rightleftarrows E + D$$

Nitration occurs in both liquid phases. The rate of nitration in Phase 1 is given by:

$$R_1 = k_1[a_{A1}{}^a a_{B1}{}^m - (a_{E1}{}^r a_{D1}{}^q/K_1)] \qquad (15)$$

In Phase 2,

$$R_2 = k_2[a_{A2}{}^a a_{B2}{}^m - (a_{E2}{}^r a_{D2}{}^q/K_2)] \qquad (16)$$

Adding an appropriate surface active agent reduces resistance to mass transfer between the two liquid phases to a negligible extent. The nitration rate itself represents the over-all rate of conversion.

Distribution of components between the two liquid phases is close to the condition of equilibrium with sufficient agitation in a tank reactor. Thus, the activity of each component in one phase is related to its activity in the other phase by the distribution coefficients K_A, K_B, K_C and K_D. Therefore,

$$a_{A1} = K_A a_{A2} \qquad (17a)$$

$$a_{B1} = K_B a_{B2} \qquad (17b)$$

$$a_{C1} = K_C a_{C2} \qquad (17c)$$

$$a_{D1} = K_D a_{D2} \qquad (17d)$$

Conversion rate in the agitated tank during nitration is the sum of the reactions in the two phases. In substituting Eqs. (17a) through (17d) into Eqs. (15) and (16), the over-all rate of nitration is represented by:

$$R = R_1 + R_2 \qquad (18)$$

Also, the activity of each component is related to its mole fraction by:

$$a_i = \gamma_i C_i \qquad (19)$$

Making the proper substitutions we can arrive at a design equation for the nitrator that is based on the material balance and kinetic equation:

$$F_{n-1}X_{n-1} = F_nX_n + V\left[(\gamma_{A1}C_{A1})^a(\gamma_{B1}C_{B1})^m\left(k_1 + \frac{k_2}{K_A{}^aK_B{}^m}\right) - (\gamma_{E1}C_{E1})^r(\gamma_{D1}C_{D1})^q\left(\frac{k_1}{K_1} + \frac{k_2}{K_2K_E{}^rK_D{}^q}\right)\right]_n$$

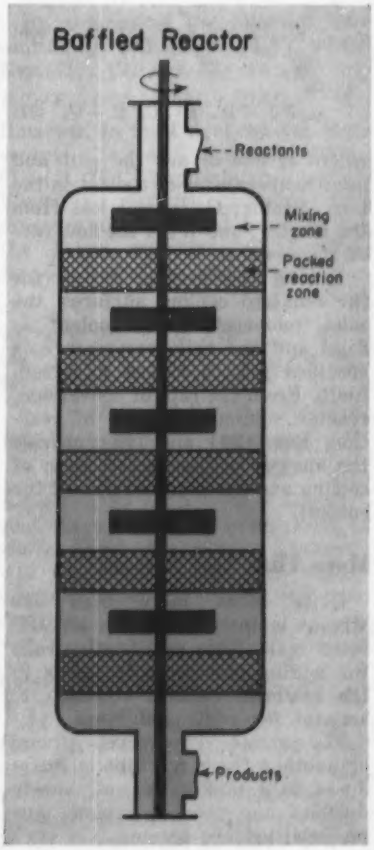
The concentrations of various components are related by the material balance and their stoichiometric ratios involved in the reaction.

Using a series of agitated tanks as a flow reactor it is an economical practice to have all the tanks identical in size and mechanical design. During the process design for such reactors, it's customary to provide the number of stages for a fixed size of tank under the specified rate of production at a specified composition.

With the design equation above applicable to each tank, one by one, from first to last, it becomes possible to find the number of tanks required between the feed and the specified composition of the product at its scheduled production capacity.

Each tank should be of such a size that the total pressure drop through the system is not excessive. The optimum size can be evaluated through a proper balance between the fixed charges and power cost.

In calculating the pressure drop through the tank, the frictional loss due to expansion at the entrance and contraction at the exit are more important than the loss through the tank itself. However, the total pressure drop through a stirred-tank reactor is much



You Need These Design Equations for a Flow Reactor

Material Balance

$$F dX = R dV \quad \text{or,} \quad F dX = R dW$$

Kinetic Equation

$$R = f(T, \pi, X, \theta, C_{AO}, C_{BO}, C_{DO}, C_{EO}, C_{NO}, C_{MO}, F, e, d, a, b)$$

Energy Balance

$$q_T R dV = w C_p\, dT + U_w D(T - t)\, dT = \text{Heat leakage}$$

Rate of Heat Transfer

$$w_c C_p'\, dT = U_w D(T - t)\, dL = \text{Heat leakage}$$

Pressure Drop Through the Reactor

$$-d\pi = 2f[G^2(1 - \epsilon)\, dL/g_c \rho \epsilon^3 D_p] \quad \text{Packed Beds}$$

$$-d\pi = 2fG^2 dL/g_c \rho D \quad \text{Homogeneous Reactors}$$

smaller than through other reactors.

To maintain a uniform temperature inside the reactor, the total surface area of the cooling tube inside the agitated reactor is calculated from the rate equation of heat transfer and the energy balance:

$$A = W_c \int_{t_i}^{t_o} \frac{C_p'\, dt}{U(T - t)} \qquad (20)$$

$$q_T R V = W_c \int_{t_i}^{t_o} C_p'\, dt + Q_L \qquad (21)$$

where t_o and t_i are the exit and inlet temperatures of coolant in the tank reactor; Q_L is heat loss from the reactor; and W_c is the flow rate of the coolant.

During the process design for the required cooling surfaces, the inlet temperature of coolant is fixed and the exit temperature is specified not to exceed a certain limit. From the rate of conversion, reactor volume and heat of reaction, Eqs. (20) and (21) provide the answer to the surface area of cooling and the required flow of the coolant.

More Than One Stream

Quite often more than one stream is introduced into an agitated tank. This modification calls for adding one or more terms in the material balance equation to account for additional input.

For example, if a recycle stream or another fresh reactant is introduced to a tank that continuously delivers one product stream, our material balance becomes:

$$F_{n-1} X_{n-1} + F_n X_n = F_n X_n - RV$$

When the appearance and disappearance of the components in the reacting system are accounted for by more than one reaction, additional rate equations should be introduced along with additional stoichiometric relations to account for the material balance of each active component. The solution of the simultaneous equation becomes more difficult and time-consuming as more reactions are involved.

Design equations for an agitated-tank reactor, for simple-order reactions have been reported in the literature. We refer you to the work of J. W. Eldredge and E. L. Piret as reported in *Chem. Eng. Progress*, 46, pp. 291-293 (1950).

Because products and reactants mix in a stirred-flow reactor, the reaction rate is reduced. For endothermic reactions that proceed adiabatically, the average temperature is lower in a stirred reactor than in a progressive type. This gives a further reduction in conversion rate. For a given rate of conversion into the desired product, the volume of a progressive tubular reactor is less than for a stirred-flow reactor.

On a costwise basis, the reduced size of the large tubes in a tubular reactor is more than offset by the low cost of tank construction for low-pressure reactors. For high pressures, the cost situation may be entirely reversed. It has been common practice to use tubular reactors for liquid reactions at high pressures and for gas reactions.

Over-all conversion in an agitated tank is improved by using tanks connected in series. With an increase in the number of tanks, performance approaches that of a tubular reactor.

Another approach is to use a tank reactor that is divided into several alternate reaction and mixing zones. Such a reactor is sketched on the preceding page.

Translating Data

To establish the kinetic equation for a liquid-phase reaction, batch laboratory systems are used frequently. Initial conditions are measured and conversion and volume of the reacting system are measured at various times. Then,

$$R = F\, dX/V d\theta$$

Note that the reaction rate is expressed in the same terms that we used for a flow reactor. Therefore, experimental reaction rates in a batch reactor can be used in our design equations for a flow reactor.

When there is a complete determination of concentration during the course of a reaction, the kinetic equation can be established with or without the aid of activity coefficient. We might evaluate the activity coefficient separately for each component. If this is impossible, we can bracket all the terms of the activity coefficients along with the rate constants and the over-all effect of temperature, pressure and composition on such a combined constant can be found.

Some reactions that are carried out in a batchwise reactor involve simultaneous contact of a gas with a liquid or of a liquid with another liquid. The validity of a scale-up procedure depends upon the reproducibility of the mixing condition in the full-scale reactor.

Key to success is the geometric similarity between the model reactor and the full-scale unit.

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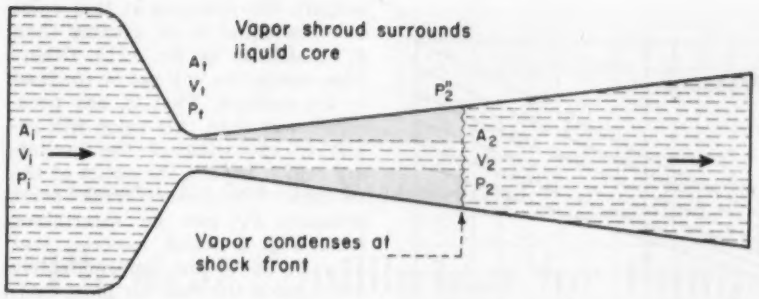
Next month the second article in this three-part series will consider the development of reactor data and how to use it to select and design your reactors as well as in catalyst selection—EDITOR.



Flow through a venturi designed to cavitate remains constant independent of downstream pressure variations

Cavitating Venturi for Flow Control

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Chemical engineers are often confronted with the problems of determining and controlling liquid flow rates. Conventional flow measuring devices such as orifices and nozzles depend on a pressure differential across the metering device. Consequently, the flow rate is affected by any fluctuations in the pressure downstream of the metering device. A cavitating venturi, however, if properly designed, is independent of downstream pressure and therefore affords a simple way of regulating and metering flow.

When a venturi has a throat so sized that the pressure at the throat is the vapor pressure of the fluid, then cavitation ensues. A typical cavitating venturi is shown above. The cavitation takes the form of a jet of liquid surrounded by a vapor shroud[2] as shown in the sketch. Condensation is believed to occur in the form of a shock[1] at the condensation surface. If the cavitating venturi is properly designed, the cavitation will be confined to the diffuser section. It is the purpose of this paper to set up parameters for design of the cavitating venturi.

The familiar flow equation for a differential metering device can be used as the design basis if the pressure at the throat is taken as the vapor pressure of the fluid:

$$W = C A_t [2g(P_i - P_v)\rho]^{1/2} \qquad (1)$$

For fully developed turbulence the entrance coefficient C, of the venturi is approximately 0.93, as contrasted to values of 0.99 for conventional venturis. This is to be expected since cavitation is in the form of a jet of liquid surrounded by a vapor shroud. Consequently, not all of the throat area is available for liquid as in the case of conventional venturis.

Upper Breakpoint Pressure

For a given inlet pressure, if the pressure at the outlet of the venturi diffuser is excessive, the venturi will not cavitate. The outlet pressure above which the venturi will not cavitate is called the upper breakpoint pressure. The system should be designed so that the pressure immediately downstream of the venturi is less than the breakpoint pressure.

If we consider the cavitating venturi of the sketch, and write Bernoulli's equation between the throat and exit, we have:

$$P_v - \Sigma F = P_t + (\rho/2g)(V_t^2 - V_v^2) \qquad (2)$$

The pressure P_v'' which actually exists at the exit of the venturi is related to ideal exit pressure P_v by frictional losses, or

$$P_v'' = P_v - \Sigma F \qquad (3)$$

By combining the equation of continuity $W = \rho A_t V_t = \rho A_v V_v$ with Eqs. (1), (2) and (3) we get:

$$P_v'' = P_i + C^2(P_i - P_t)[1 - (D_t/D_v)^4] \qquad (4)$$

However, in most applications, the venturi is so designed that $[1-(D_t/D_v)^4]$ approximates unity. When the venturi cavitates the pressure at the throat is equal to the vapor pressure or $P_t = P_v$. Eq. (4) therefore reduces to:

$$P_v'' = P_v + C^2(P_i - P_v) \qquad (5)$$

which is plotted in Fig. 1 for various values of C. Eq. (4) can be rearranged to yield:

$$P_i = (P_v'' - C^2 P_i) / (1 - C^2) \qquad (6)$$

And for a given inlet pressure,

$$P_i = (P_v'' - \text{const.}) / \text{const.} \qquad (7)$$

According to Eq. (7) it is evident that there is an exit pressure P_v'' above which the throat pressure will be greater than the vapor pressure, hence the venturi will not cavitate.

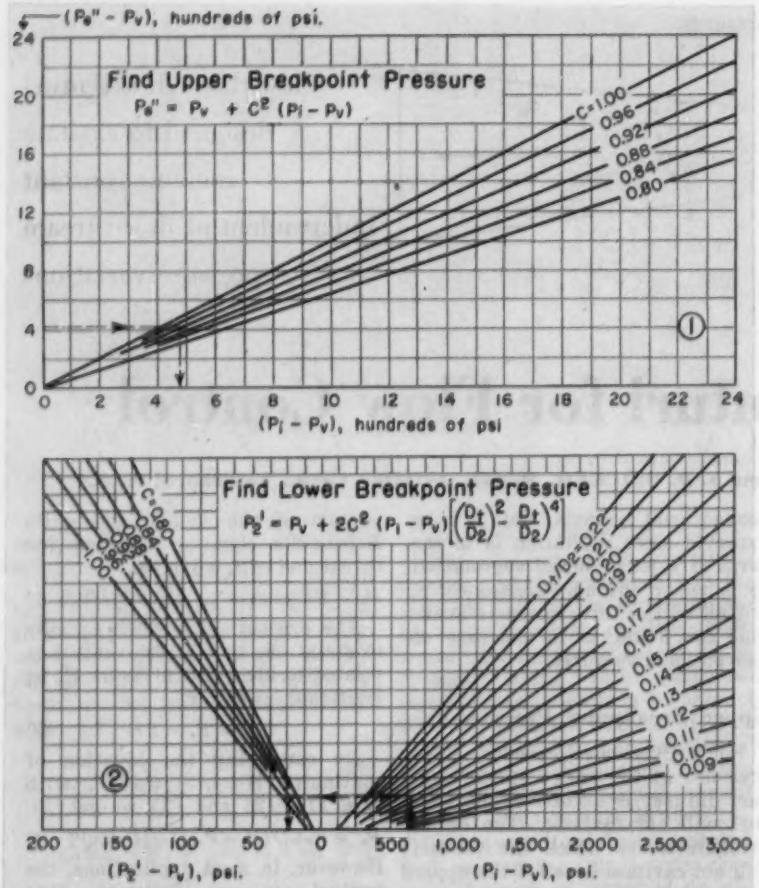
Lower Breakpoint Pressure

As we have already seen, cavitation occurs as a liquid jet surrounded by a vapor shroud, with condensation taking place as a shock at the condensation surface. If the downstream pressure is low

Nomenclature

A	Area, sq. ft.
C	Entrance coefficient, dimensionless.
D	Diameter, ft.
F	Friction losses, lb./ft.^{2}
g	Gravitational constant, ft./sec.^{2}
P	Pressure, lb./ft.^{2}
P_v	Ideal exit pressure, not corrected for frictional losses, $P_v = P_v'' + \Sigma F$, lb./ft.^{2}
P_v''	Upper breakpoint pressure.
P_2'	Pressure immediately downstream of condensation surface; when Section (2) is taken at the outlet of the venturi, then P_2' is the lower breakpoint pressure, lb./ft.^{2}
P_2''	Pressure immediately upstream of the condensation surface.
P_v	Vapor pressure, lb./ft.^{2}
W	Flow rate, lb./sec.
ρ	Density, lb./ft.^{3}
Subscripts	
i	Inlet section of venturi.
t	Venturi throat.
2	Any section in the venturi diffuser.

* Meet your authors on page 413.



In Figs. 1 and 2 note that pressures, which are given as lb./sq. ft. in the equations, have been converted to lb./sq. in. for convenience in use.

enough, the cavitation can extend downstream of the diffuser. For some applications this condition may be undesirable. It is therefore necessary to know the minimum downstream pressure required to confine the condensation surface to the diffuser section.

For the purpose of analysis, we assume that a liquid core of diameter equal to the throat diameter is surrounded by a shroud of vapor. At the condensation surface, a shock occurs with the vapor abruptly changing to liquid.

The conservation of momentum across the condensation surface yields:

$$A_3(P_3' - P_3'') = (\rho/g)\, V_3 A_3 (V_i - V_3) \quad (8)$$

Bernoulli's equation taken between the venturi inlet and throat, and corrected for losses by use of an entrance coefficient, will give:

$$(\rho/2g)\,(V_t^2 - V_i^2) = C^2(P_i - P_t) \quad (9)$$

Dividing Eq. (8) by Eq. (9) and bearing in mind that $P_s'' = P_t = P_v$, we get:

$$\frac{P_3' - P_v}{P_i - P_v} = 2C^2\,\frac{V_3(V_i - V_3)}{V_i^2 - V_t^2} \quad (10)$$

With the aid of the equation of continuity $V_t A_t = V_i A_i = V_3 A_3$, Eq. (10) becomes:

$$\frac{P_3' - P_v}{P_i - P_v} = 2C^2\,\frac{(D_t/D_3)^3 - (D_t/D_3)^4}{1 - (D_t/D_i)^4} \quad (11)$$

The lower breakpoint pressure is defined as the pressure immediately downstream of the venturi below which the cavitation will extend past the outlet of the venturi. With Section (2) at the outlet of the venturi, the pressure at this point must be equal to or greater than P_3' as defined by Eq. (11). Otherwise, cavitation will not be confined to the venturi. That is, any pressure lower than this value will result in extension of the cavitating region beyond the outlet of the venturi. The lower break point pressure P_3' can be determined from Fig. 2 which assumes that $[1-(D_t/D_i)^4]$ is approximately unity, as is the case for most cavitating venturis.

A Typical Example

A liquid whose specific gravity is 1.0 and whose vapor pressure P_v is 85 psig. flows into a reactor at 10 lb./sec. Reaction pressure will fluctuate between 400 and 500 psig. It is desired to install a cavitating venturi immediately upstream of the reactor to control and meter the flow.

To insure the venturi cavitating, the minimum allowable inlet pressure is determined by Fig. 1. At $P_s'' - P_v = 500 - 85 = 415$ psig., and $C = 0.93$, Fig. 1 yields $P_i - P_v = 480$ psig. Therefore, $P_i = 480 + 65 = 565$ psig., which is the minimum allowable inlet pressure to the cavitating venturi. Should the inlet pressure drop below this value, the venturi will not cavitate. Applying a safety factor to our system, let $P_i = 700$ psig., which is sufficiently greater than 565 psig.

The throat size is now determined by Eq. (1): $A_t = 10/0.93 \times 1/[2 \times 32.2\ (700-85)\ (62.4/144)]^{\frac{1}{2}} = 0.0819$ sq. in. From this we calculate $D = 0.323$ in.

To determine whether the cavitation region will be confined to the diffuser section of the venturi we refer to Fig. 2 to determine the lower breakpoint pressure. Entering Fig. 2 with $P_i - P_v = 700 - 85 = 615$ psig., $C = 0.93$ and $D_t/D_3 = 0.15$, we find $P_3' - P_v = 23$. Consequently, $P_3' = 108$ psig. Because the pressure immediately downstream of the venturi is greater than the lower breakpoint pressure, the cavitation region will not extend past the outlet of the venturi.

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Chemical Engineering Fundamentals

Physical Equilibrium for Equipment Design

To get more valuable end products, chemical engineers often rely on physical separation equipment. Are your fundamentals getting rusty?

JAMES O. OSBURN, State University of Iowa, Iowa City, Ia.*

WITH the aid of previous installments of this CE Refresher series, we now have a reactor built and it is operating satisfactorily to produce the desired quantities of our product *D*. Our product is made in the simple chemical reaction

$$A + B \rightarrow C + D$$

Now, do you think we are ready to condense the stuff that leaves the reactor, run it into drums, label it and turn it over to the sales department?

Not so fast! Let's see how our product from the reactor compares with specifications that have been set up by the sales department. They call for a minimum of 99% *D*.

The report from the analytical lab brings us bad news. Instead of pure unadulterated *D*, they tell us we have a mixture of *D* and other substances:

- Unreacted *A* and *B*.
- The *C* formed along with D.
- Some *R* and *S* formed by side reactions.
- *X*, *Y*, and *Z* which were present as impurities in the reactants.

Physical Separations Needed

Our job is only partly done when we design a chemical reactor. Next, we have to design equipment that will separate the various products of reaction into relatively pure fractions.

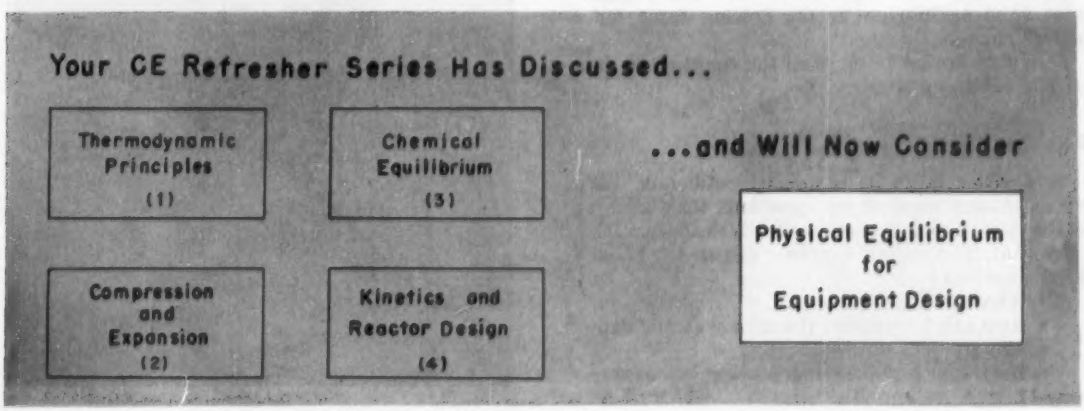
Sometimes this means more chemical reactions. But usually a physical separation—distillation, absorption or extraction—is simpler and cheaper.

As things work out in many plants, more equipment is used for separations than for reactions. To illustrate this, thumb through some back issues of *Chemical Engineering* and glance at some flow diagrams. Count the number of reactors and compare this with the number of process units shown for phase separations on these diagrams. A random selection gave us these results:

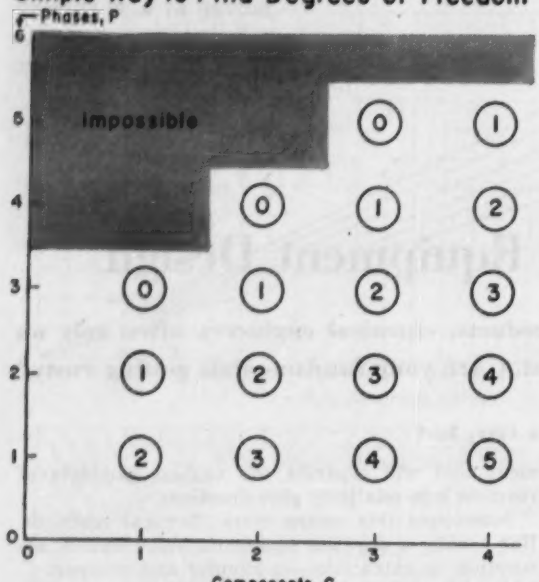
Process	Reaction Vessels	Phase Separation Units
TCC for polymer gasoline	2	5
Aromatics from coal	2	10
Ethylene	4	8
Butadiene	4	15
Synthetic detergent	3	3
Acrylonitrile	3	11
Methanol	2	4
Catalytic dehydrogenation	3	7

Work it out for your plant. Chances are you will find that the phase-separation units far outnumber the reaction vessels.

*Meet your author on p. 415.


Your CE Refresher Series Has Discussed...
Thermodynamic Principles (1)
Chemical Equilibrium (3)
Compression and Expansion (2)
Kinetics and Reactor Design (4)
...and Will Now Consider
Physical Equilibrium for Equipment Design

Simple Way to Find Degrees of Freedom



Numbers in circles indicate the degrees of freedom – Fig. 1

Of course, the design of physical-separation equipment may not require as much engineering time and talent as the complete design of a chemical reactor. However, physical-separation units do represent a considerable part of the investment in modern chemical process plants. Your skill as a chemical engineer in the management of this investment will depend on how familiar you still are with the fundamentals of physical equilibrium.

Why Review Physical Equilibrium?

To design a still, an absorber or an extractor we need two kinds of data:

- Physical equilibrium relationships.
- Rate data.

The equilibrium relationship gives a limiting value, which could be attained with perfect equipment or infinite time. Rate data tell us how closely we approach the equilibrium condition. The displacement from equilibrium is the driving force for a desired change.

Rate data are no better than the equilibrium data used in obtaining them.

What is Equilibrium?

This series is about physical equilibrium. We'll try to answer some of the questions that come up in the design and operation of physical-separation equipment. The design engineer might ask himself these questions:

- What data do I need?
- How can I represent the data systematically?
- Are my data any good?
- How can I reduce the amount of data required?
- Under what conditions can a process be carried out?

Physical equilibrium deals with the relationships between the compositions of phases and the conditions under which the phases exist.

Each chemical component in a mixture is called a component. If one compound can be formed by reactions between others, and there is chemical equilibrium, the number of components is correspondingly less. But when we talk about physical equilibrium, chemical reactions are ruled out. So the number of components in physical equilibrium is the same as the number of chemical substances.

The substances may exist in either solid, liquid or gaseous phases. Only one gaseous phase can be present, because all gases are miscible. There may be two or more liquid or solid phases in equilibrium. Each phase is homogeneous and has a definite phase boundary. The components are distributed among all phases, although some concentrations may be very small.

When we have a condition of equilibrium, the things that may change the equilibrium are usually changes in temperature and pressure. At equilibrium all phases are at a uniform temperature and a uniform pressure.

Sometimes there are variable surface, electrical or other potentials. These change the equilibrium.

Phase Rule Predicts Equilibrium

To find out what kind of physical equilibrium may exist under a given set of conditions, we can use the Gibbs phase rule. This rule gives us the relationship between the number of components, C, the number of phases, P, and the number of degrees of freedom, F. The rule is rather simple:

$$P + F = C + 2$$

Using the rule can be made even simpler by plotting out the possible combinations on a diagram such as that shown in Fig. 1 on this page. For example, if we have two components in equilibrium in two phases, there are two degrees of freedom.

Degrees of Freedom: One Component

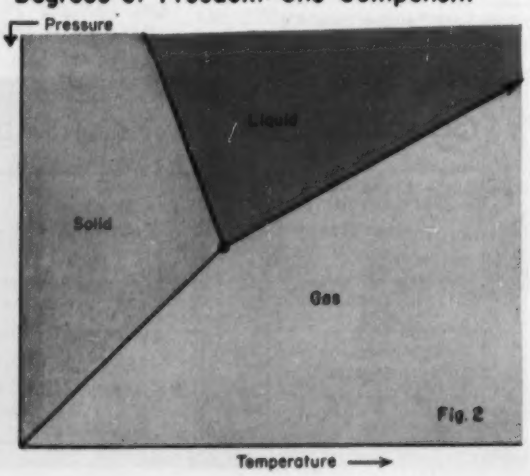


Fig. 2

For the combinations marked in the impossible zone of Fig. 1, the phase rule gives us a negative value for degrees of freedom, F. This means that equilibrium cannot exist under such conditions.

Let's Define Degrees of Freedom

On an equilibrium diagram that relates temperature, pressure and compositions, for example, there are certain characteristics that appear on the diagram and that are related to the degrees of freedom. They are:

Characteristic	Degrees of Freedom
Point	0
Line	1
Surface	2
Space	3
Requires four dimensions	4

Up to now we haven't defined the term *degree of freedom*. Now let's show what this term means by giving some examples.

In describing an equilibrium condition there are certain variables which we must identify. These are the temperature, the pressure and the fraction of each component present in each phase.

Fig. 2 is a typical pressure-temperature diagram for a pure substance. Since only one component is present, its composition is 100% in each phase. Only the temperature and the pressure can vary. At the triple point, marked *0* on Fig. 2, there are zero degrees of freedom. At this point, three phases are in equilibrium.

There is only one triple point for these three phases, and at this point both the temperature and the pressure are definite and unique. We have no *freedom* to choose either the temperature or the pressure if we insist on having equilibrium between these three phases. Zero degrees of freedom is represented by a point.

One degree of freedom means that we may choose one condition—either temperature or pressure. The other is fixed. This condition is represented by a line on Fig. 2.

Therefore, the number of degrees of freedom is the number of independent variables (temperature, pressure, phase compositions) that may be chosen before the equilibrium is fixed.

To represent completely the equilibrium between two components A and B, we need three dimensions. The variables are temperature, pressure and weight or mole fraction of A. We can then calculate the fraction of B since the sum of the weight or mole fractions in any phase must add up to 1.0.

Instead of trying to work with a three-dimensional figure, we hold one of our variables to a constant value. This reduces the number of degrees of freedom by one. Figs. 3a, 3b and 3c show the kind of diagrams that we get. One line on each of these diagrams represents the concentration in one phase. The other line refers to the concentration in the other phase. On the pressure-temperature diagram, these lines come together at the critical point, known as the critical temperature.

How to Show Three Components

Three-component systems are reduced to two dimensions by fixing the temperature and pressure. This reduces the number of degrees of freedom by two. And we use this special form of the phase rule:

$$F + P = C$$

or, since C is equal to 3,

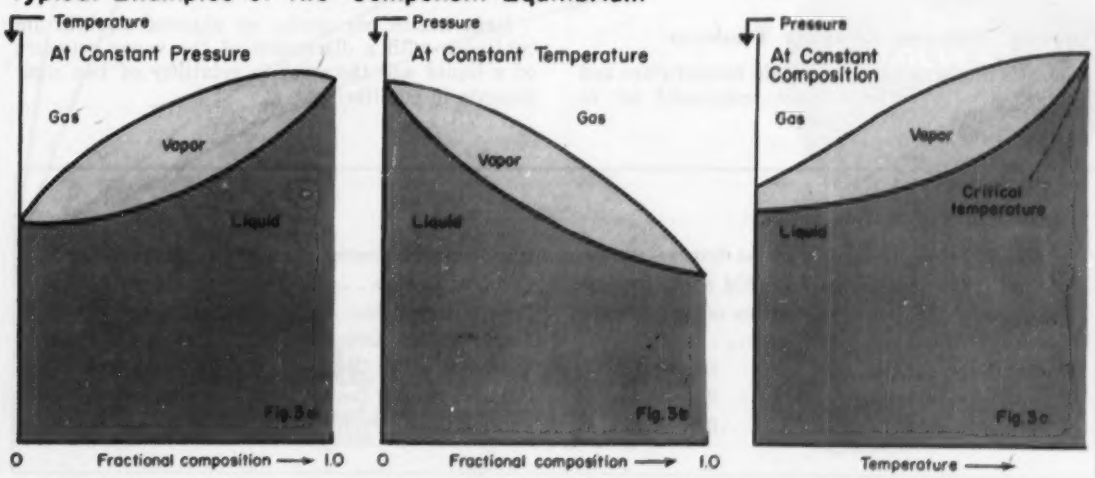
$$F + P = 3$$

The two remaining variables are two compositions, and the phase equilibrium is shown in a diagram such as Fig. 4 on the next page. The existence of three phases gives zero degrees of freedom shown by points marked *0* on Fig. 4. Lines on the diagram describe one degree of freedom, obtained when two phases are in equilibrium.

Certain areas, labeled *2* on Fig. 4, are for two degrees of freedom, obtained with one phase.

Four components are about the largest number for which we try to draw diagrams. For larger num-

Typical Examples of Two-Component Equilibrium



Three-Component System

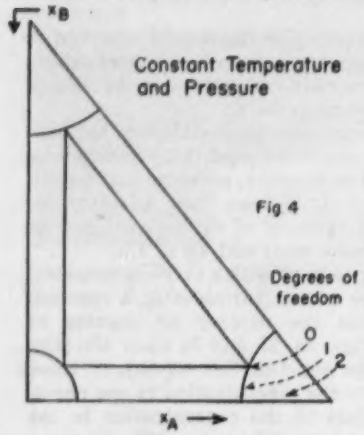


Fig 4

An Example of Four-Component Equilibrium

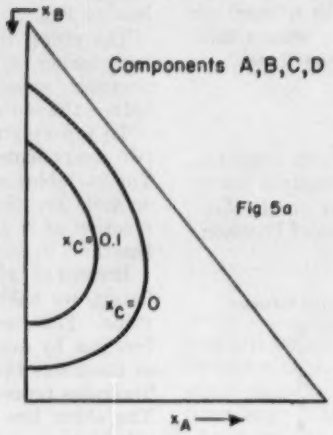


Fig 5a

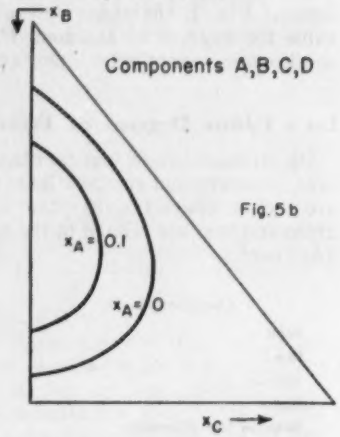


Fig. 5b

bers, often encountered in actual physical situations, we make some simplifying assumptions to permit an analytical treatment. Or we group several compounds together into a *pseudo-component*.

To show four-component equilibrium in two dimensions we hold the temperature, the pressure and one component constant. This gives us diagrams such as those shown in Figs. 5a and 5b. In this case we have held D constant.

A More General Phase Rule

The phase rule as we gave it above is based on the assumption that all conditions except temperature and pressure are constant. Now what can we do if there are other variable potentials?

Well, if we let R equal the number of external variables such as temperature, pressure, electric potential or magnetic field, the phase rule becomes

$$F + P = C + R$$

By evaluating R, we can arrive at a statement of the phase rule for any particular set of physical conditions that we may find.

Fugacity Measures Escaping Tendency

When a phase exists at a certain temperature and pressure, the molecules of each component are in constant motion within the phase. A certain number of these molecules manage to leave the phase and escape to a neighboring phase. This escaping tendency of the molecules in any phase is called the *fugacity*.

At equilibrium between two phases the escaping tendencies of the phases are balanced and the fugacity of a component is the same in every phase that is present.

For an ideal gas the fugacity is equal to the pressure, and fugacity has the units of pressure. For a nonideal gas, the fugacity is calculated from the equation that defines it:

$$\ln\left(\frac{f}{p}\right) \quad \int_0^p \left(\frac{z-1}{p}\right) dp$$

A correlation of fugacity with reduced temperature and pressure was given in a previous installment of this CE Refresher series (*Chem. Eng.*, April 1954, p. 212).

The fugacity of a liquid is calculated from that of the vapor in equilibrium with it.

Coming: Vapor-Liquid Equilibrium

Next month our series on physical equilibrium continues with a discussion of the vapor pressure of a liquid and the relative volatility of two components in equilibrium.

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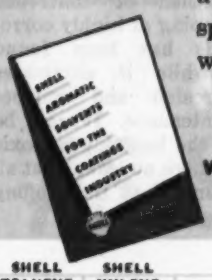

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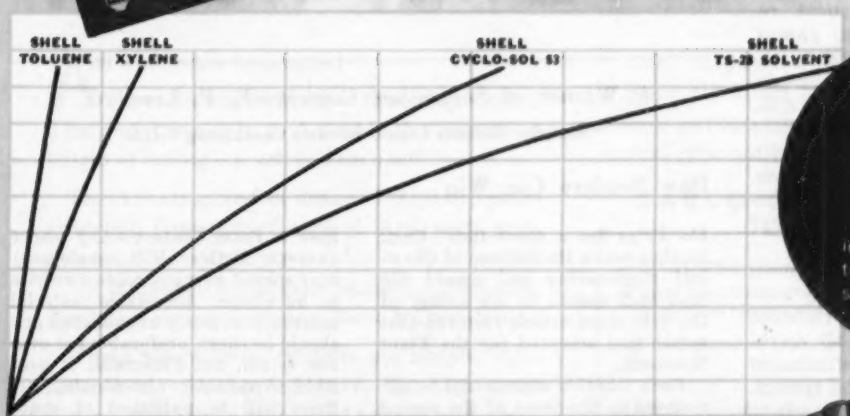

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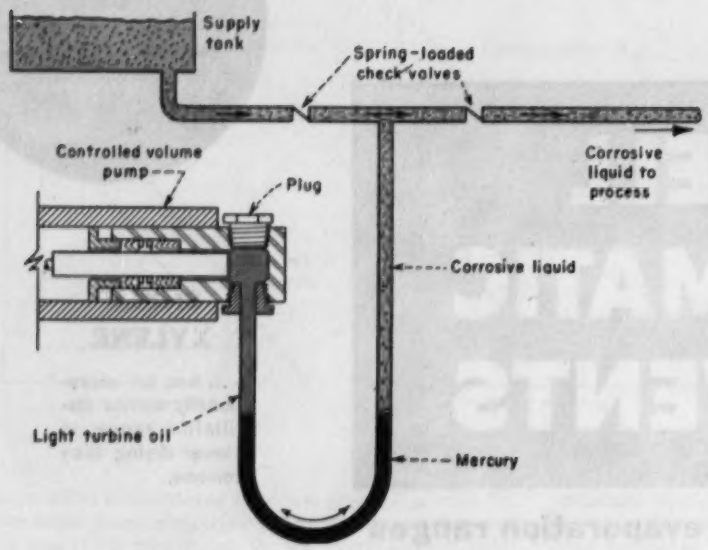


★ **Winner of August Contest**

"Liquid Piston" Defeats Pump Corrosion

An easy way to handle corrosives with controlled volume pumps is to interpose a liquid seal between pump and line

Vance O. Bonnichsen

Owner, The Chem-Quip Co., Pensacola, Florida.

The sketch above shows a method I have developed for pumping highly corrosive liquids with positive displacement reciprocating type piston pumps. Frequently we encounter problems in handling these materials, either because of packing difficulties or because of corrosion of the pump head and body, with resultant liquid contamination. This also means high maintenance costs on valves and other parts.

Since the arrangement shown in the sketch prevents any contact of the corrosive material with the pump itself, all corrosion problems can be eliminated from that portion of the system.

Essentially, what is done is to relocate the suction and discharge valves from the pump head, and place them in the line through which the hard-to-handle material is flowing. These then become spring-loaded check valves which allow flow in only one direction as the pump piston moves through its reciprocating cycle.

The normal discharge, or top, opening in the pump head is plugged after removal of the valves, while the lower opening is connected by a loop seal to the liquid line at a point between the check valves.

The liquid used as the "liquid piston" must be immiscible with, and chemically unreactive with, both the liquid being pumped and the captive liquid in the pump. Mercury has been found suitable for service as the sealing liquid in many cases. Of course, the design and sizing of the sealing loop depends on the pump displacement and its discharge pressure. It is obvious that it must have enough capacity to prevent carryover of the sealant into the liquid being pumped.

For the captive liquid it is advantageous to use a light turbine oil or some similar medium with good lubricating properties. This aids in lengthening packing life and almost completely eliminates pump maintenance.

This method of controlled volume pumping of highly corrosive liquids has been found accurate, while it eliminates pump corrosion and reduces pump maintenance. It can be adapted to the handling of toxic materials where no leakage at all can be tolerated at the stuffing box.

★ **Winner of September Contest—E. F. Leonard**

"Sampler Handles Liquid Streams Containing Solids"

How Readers Can Win . . .

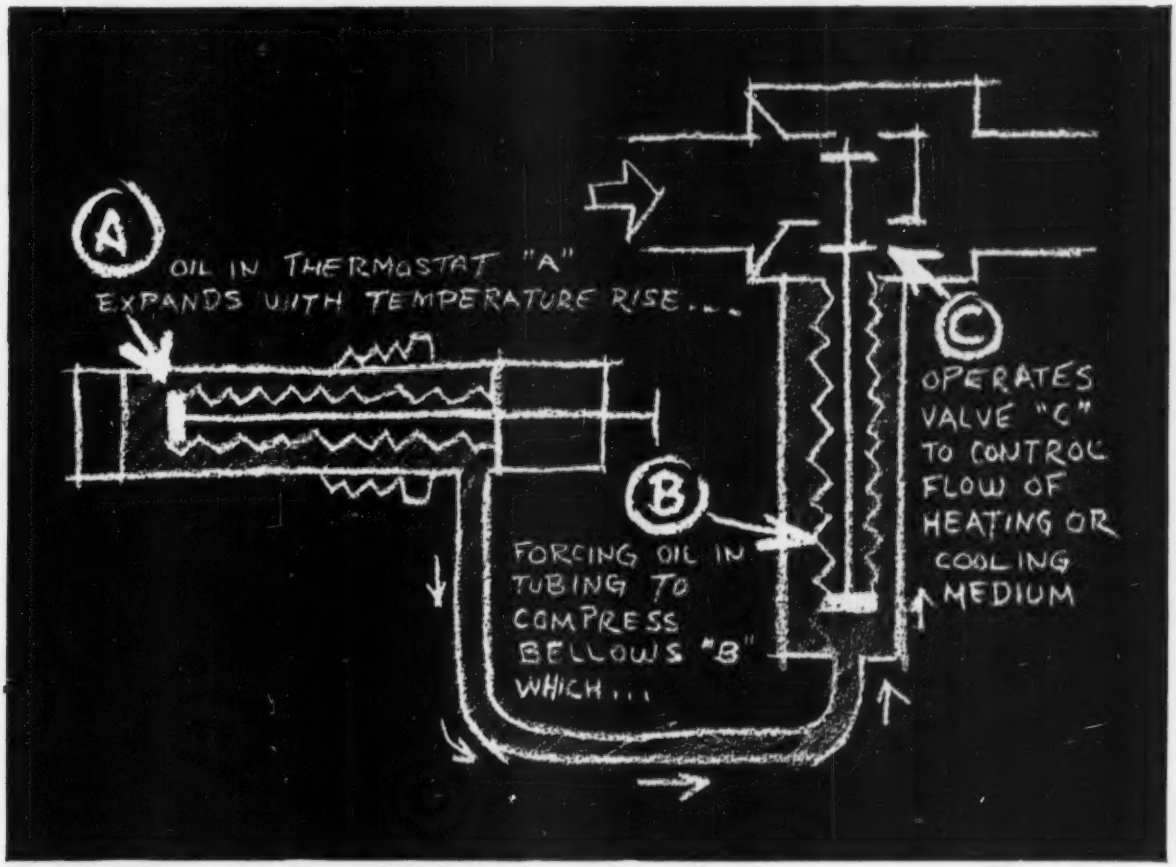
$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

Each month's winner will be announced in the issue of the second following month, and published the third following month.

$100 Annual Prize—At the end of each year the monthly winners will be rejudged, and the year's best winner awarded an additional $100 prize.

How to Enter Contest—Any reader (except McGraw-Hill employees) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 min.).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, of interest to chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.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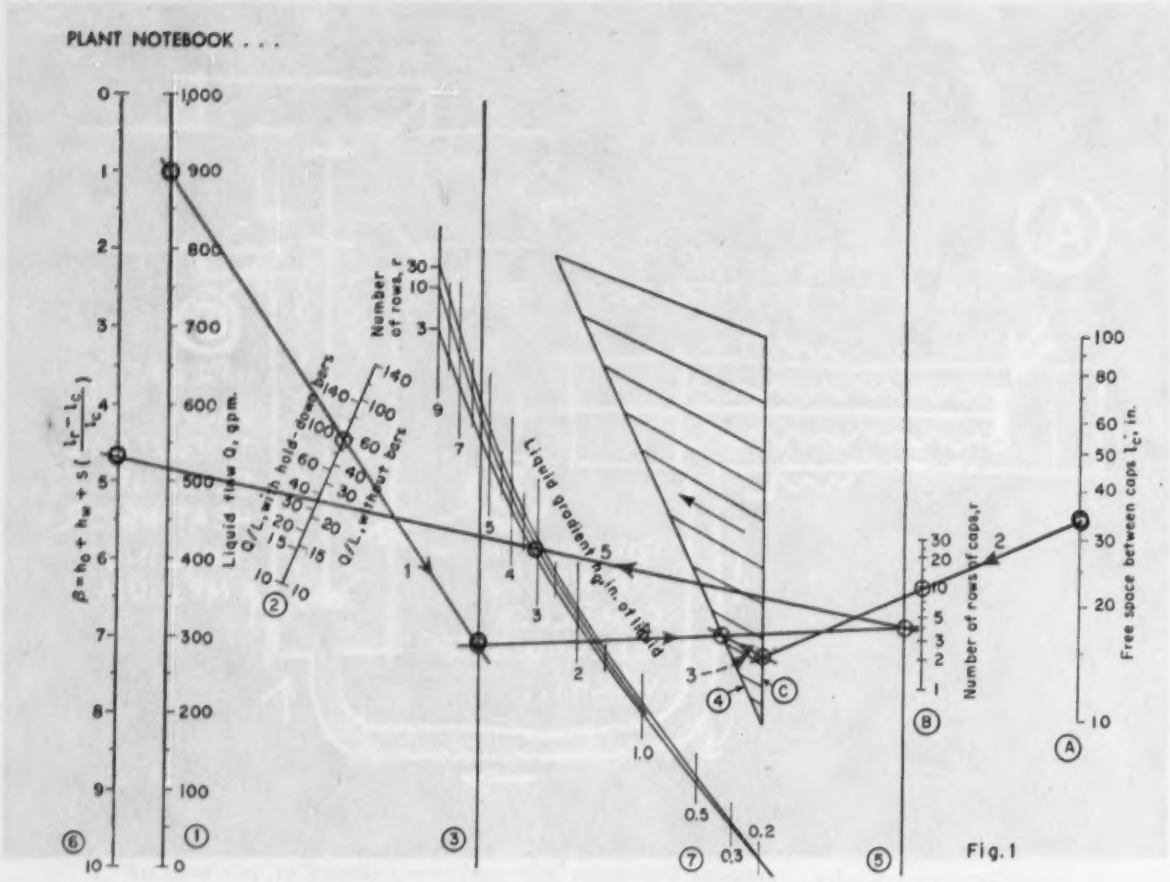

Liquid flow Q, gpm.
Q/L, with hold-down bars
Q/L, without bars
Number of rows, r
Liquid gradient, in. of liquid
Number of rows of caps, r
Free space between caps l_c, in.
Fig. 1

Chart Gives Liquid Gradient on Plates

Ferdinand Rodriguez
Registered Chemical Engineer (Ohio), Parma, Ohio.

In the calculations for bubble-cap columns an important factor is the liquid gradient h_g across the plates. An equation for this quantity is that of Davies (*Ind. Eng. Chem.*, 39, 774, 1947) which assumes round caps spaced on equilateral triangles:

$$Q = 2.15\, C\, l_e\, h_g^{3/2}\, r^{-1.5}\, Z$$

where $Z = h_g\,(1.5r - 1.4) + 3r\beta$; $C = f\,(Q,\ Q/L)$, and $\beta = h_o + h_w + s\,(l_r - l_c)/l_c$.

A trial-and-error solution is necessary for h_g. However, the equation can be rearranged in the form:

$$Q = f(Q, Q/L) \cdot g(l_e, r) \cdot j(h_g, r, \beta)$$

I have constructed a nomograph to give a direct solution for h_g on this basis (see Fig. 1). Fig. 2 is a supplementary chart to solve the Francis weir formula, $h_o = (Q/2.98\, l_w)^{0.667}$.

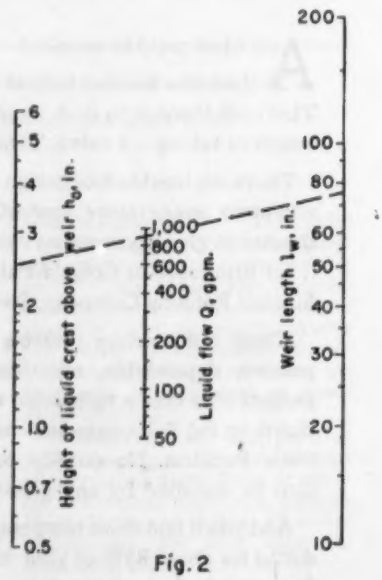
Table I—Quantities in Problem

Q,	Liquid flow	900 gpm.
L,	Over-all average flow width	9 ft.
l_w,	Weir length	75.1 in.
l_e,	Free space between caps, normal to flow	32.95 in.
r,	Numbers of rows of caps	11 rows
h_w,	Weir height	2.0 in.
s,	Clearance between cap skirt and plate	0.375 in.
l_r,	Free space between risers normal to flow	51.1 in.

Table II—Key to Nomograph

1→2→3	3→4←5
A→B→C	5→6
C→4	Read h_g on 7

Table I summarizes the dimensions and flow rate of a tower for which we want to find the liquid gradient. We calculate $Q/L = 100$, find $h_o = 2.5$ from Fig. 2, and calculate $\beta = 2.5 + 2.0 + 0.2 = 4.7$ in. Using Fig. 1 according to Table II we find, for $r = 11$, that $h_g = 3.1$ in.



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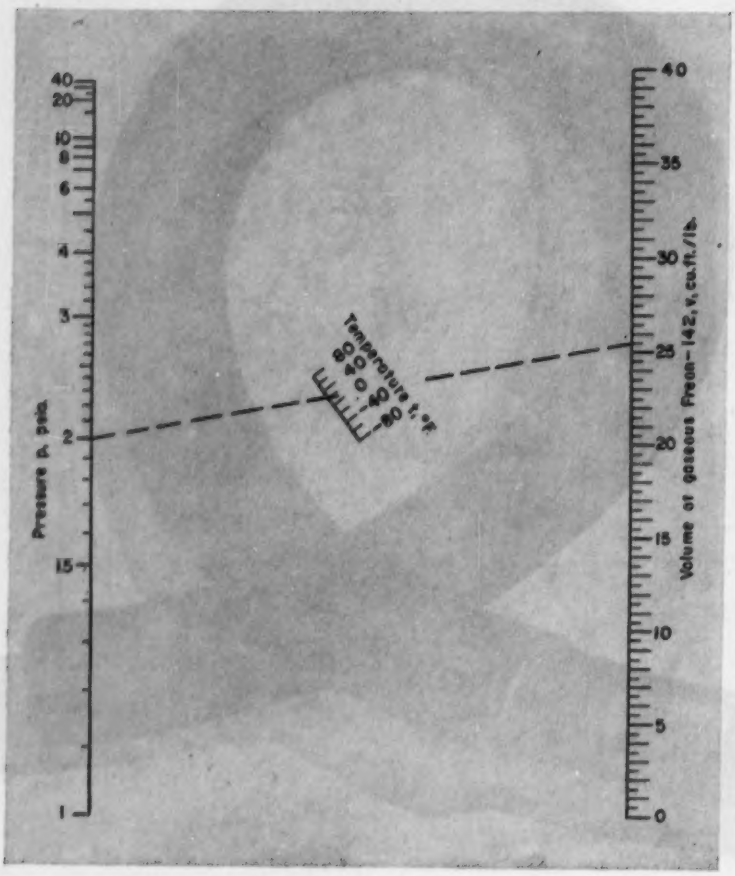


P-V-T Relationships of Freon-142

Dale S. Davis

Professor of Engineering, University of Alabama, Tuscaloosa, Ala.

To express the pressure-volume-temperature relationships for monochlorodifluoro ethane (Freon-142), a material used in heat pumps, Riedel (*Z. für die gesamte Kälte Industrien*, 48, 105, July 1941) gives an equation which, on substituting English for metric units, becomes:

$$v = 0.1067\ \frac{T}{P} - \frac{202{,}000}{T^{3.3}}$$

where v = volume of 1 lb. of gas, cu. ft.; T = absolute temperature, °Rankine; and p = absolute pressure, psia.

The nomograph above solves this equation conveniently. What is the volume of 1 lb. of gaseous Freon-142 if the pressure is 2 psia. and the temperature is 20 F.? The broken line shows the volume to be 25.5 cu. ft. per lb. under these conditions.

Safety Kink in Using Glass Tubing

T. L. Brown

Research Chemist, Technical Development Dept., Cutter Laboratories, Berkeley, Calif.

On occasions when the chemical engineer must use glass tubing and thermometers in the pilot plant, inserted in the usual way through rubber stoppers, it is well to recall the nasty cuts that can result from careless insertion in the stopper hole.

A safe way is to select a cork borer (or end-sharpened thin-wall metal tube) which is just slightly larger internally than the outside diameter of the glass tube or thermometer. Bore the hole in the customary way and push out the rubber core from the boring tool while it is still inserted in the stopper. Then insert the glass tube through the boring tool (from the side opposite the handle) and withdraw the tool, leaving the glass in place.

Two Ways to Stop Gage Glass Breakage

Paul C. Ziemke

Maintenance Engineer, Oak Ridge, Tenn.

Some years ago we were faced with a problem of breakage of 5-ft. long gage glasses installed in the ends of a bank of 30,000-gal. storage tanks. Although the circumstances were somewhat unusual, it is likely that others may face the same difficulty—and probable that the same solutions will cure the trouble.

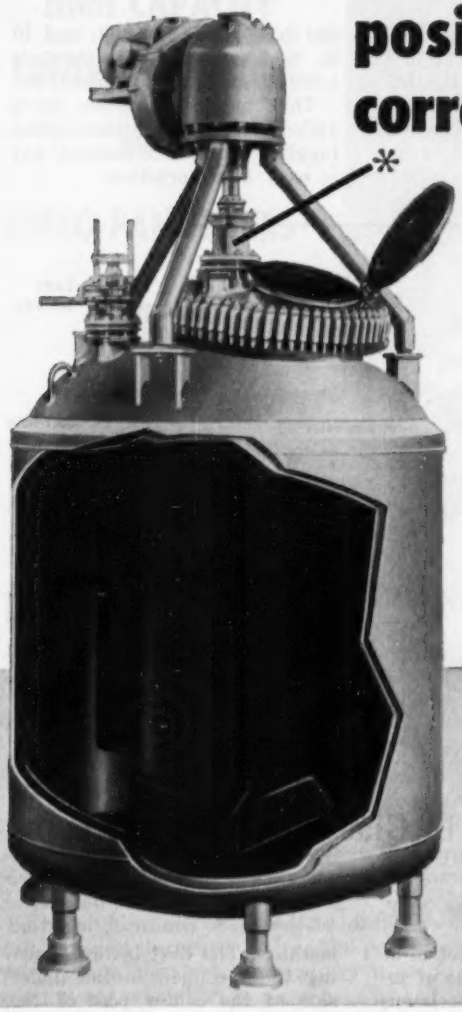
The plant itself was subject to rough Canadian winters and as a consequence the tanks were buried under 8 ft. of soil and installed with one end extending through the concrete wall of the pump house. A 4 x 4-ft. recess in the concrete wall above each tank gave ready access to the manholes. The arrangement made it easy to connect the necessary piping for filling and emptying, and also easy to get at the manholes for periodic cleaning operations. Gage glasses 5 ft. long were installed in the inner ends of all tanks so as to be visible from inside the pump house.

However, the gage glass arrangement was unsatisfactory owing to frequent breakage due to expansion and contraction, coupled with vibration set up by the pumps.

The situation was improved by cutting a section out of the middle of each glass and installing a flexible section of heavy-duty hose which was made tight with Glyptal cement and a pair of brass hose clamps.

Later on, additional tank capacity was needed to take care

Glascote glass-lined reactors give you more years of positive protection against corrosion and contamination



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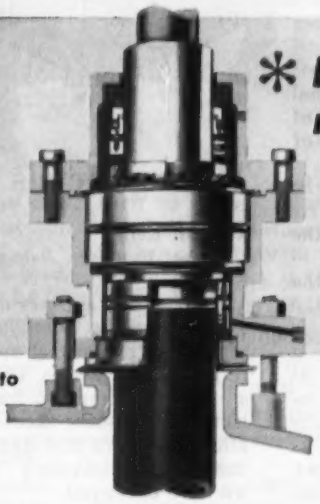

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Ask the representative who calls on you for all the facts about Glascote products — reactors, storage tanks, columns, conical rotary dryer-blenders, receivers, condensers and accessory products. Or, if you prefer, write direct. Glascote Products, Inc., Cleveland 17, a subsidiary of A. O. Smith Corporation.

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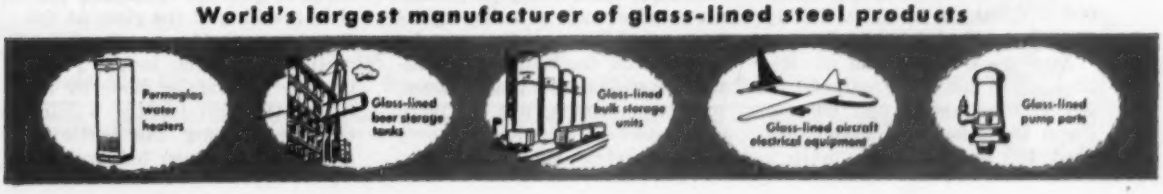
World's largest manufacturer of glass-lined steel products



of increased business. The new tanks were ordered with special gage-glass connections instead of the one-time standard single gage glass. The new specifications called for two gage glasses, each one measuring half the tank contents. These were installed staggered and overlapping at the tank center so as to measure levels over the entire diameter.

Calculating Blends of Sublots of Material

Richard L. Hunter
Chemical Engineer, Towanda, Pa.

Suppose we wish to mix several components having different physical values to produce a blend of a desired value. Assume that moisture content is the criterion. The method to be described is more versatile than previously used methods, since it can take care of any number of components.

There are three simple steps:

1. Multiply the desired final weight by the desired value of moisture to find the number of "moisture units" in the blend.
2. Multiply the available weight of each component by its moisture content to find the "units" available in each.
3. Combine the "units" of the various components to match the desired blend "units."

Ordinarily there will be a large number of possible blends which will give the desired number of blend units, but usually some controlling factor such as cost will indicate the best blend. Assume our most expensive material has the least moisture.

Example—We want to blend 1,000 lb. of material, to contain 15% moisture. Our four components are available in weights and moisture contents as follows: 800 lb., 5%; 600 lb., 10%; 400 lb., 18%; and 200 lb., 20%.

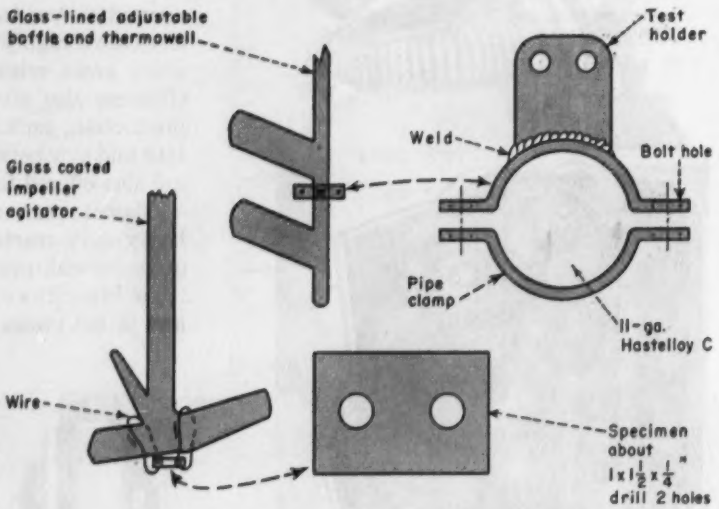
Step 1—15 × 1,000 = 15,000 "units" needed for the blend.

Step 2—Available materials contain 5 × 800 = 4,000; 10 × 600 = 6,000; 18 × 400 = 7,200; and 20 × 200 = 4,000 "units."

Step 3—We will use all the cheaper 18 and 20% material to get 11,200 "units" and 600 lb. From the other two sublots we need 400 lb. and 3,800 "units." Use of simultaneous equations shows we need 360 lb. of the 10% material, and 40 lb. of the 5% material.

The final result then consists of 200 lb. @ 20% = 4,000 "units"; 400 lb. @ 18% = 7,200; 360 lb. @ 10% = 3,600; and 40 lb. @ 5% = 200. The total is 1,000 lb. and 15,000 "units."

This method becomes more difficult with more sublots, since juggling of units is needed, but is easy after practice.



Testing Metals in Glass-lined Vessels

Kenneth Kelly
Chemical Engineer, Delmar, N. Y.

Information appears not to be available on the technique of inserting corrosion test specimens in glass-lined kettles. This is not a usual requirement, but sometimes it becomes necessary, so other engineers may find use for the two satisfactory methods we have developed.

Utility of the methods is most likely when determining suitable construction materials for possible replacement of existing reactors, or for future large-scale expansion.

Usual exposure time for such corrosion tests is 2 to 3 months under actual service conditions before it is possible to recommend materials for major units. However, process piping and accessories such as coils, agitators and thermowells can be specified on the basis of laboratory corrosion tests in glassware, with exposure to one or more charges.

The sketch shows the two methods. The first involves wiring the specimen to the under side of the center post of the agitator, making sure the wire is of the same material as the specimen to prevent possible galvanic action. Teflon thread and glass fiber rope can be wrapped around the agitator blades as added protection.

If wire cannot be used, or several samples require testing, then the specimen can be supported with a 2-in. Hastelloy C pipe clamp bolted to the baffle arm and encased thermowell. The righthand sketch shows such a clamp, with welded-on sample holder. Teflon tape (made by 3-M Co.) is first wrapped around the baffle to prevent shock and possible cracking of the glass as the clamp is pulled up snug *only*. A preliminary check before starting the run can be made by rotating the agitator for 5 min., then re-entering the kettle to check the specimen holders.

HIGH CAPACITY CLEAN DISCHARGE WITH EIMCO PAN FILTERS

Detail of Eimco stainless-steel pan-filter showing flexible vacuum and blow connections to each pan. These are exclusive features on the Eimco Pan Filter — particularly advantageous when the slurries filtered require periodic clean-outs of internal parts.

Greater filtering capacity, cleaner discharge and superior washing and drying make the Eimco Pan Filter a highly efficient unit.

Each pan functions as an individual filter with feed, wash, dry and discharge cycles. The pans may be jet washed from the bottom, assuring a clean media during every revolution.

Eimco Pan Filters can be constructed from a wide range of materials to ensure long life and low maintenance when processing corrosive slurries. Materials such as rubber, plastic and many others may be bonded to the surface of the metal construction for protective coating or to prevent product contamination.

Pan filters are available in a variety of sizes from 10 to 500 square feet of filter area.

These and other outstanding features listed below in a comparison with table filters, make the Eimco Pan Filter the most practical and efficient horizontal type vacuum filter available.

	TABLE FILTERS	EIMCO PAN FILTERS
Cake Discharge	Heel of cake remains on media.	Clean, full cake discharge.
Washing	No clear separation of wash. Cake remaining on media carries liquor past cake discharge point, diluting the strong filtrate.	Absolute separation of wash.
Media	Becomes blinded easily. Must stop to remove cake and wash. (Phosphoric acid operation requires considerable downtime.)	Media kept clean through wash during each cycle. Downtime minimum.
Removing, Repairing Media	Difficult repair job.	Media on each pan is easily and quickly changed or repaired.

Let Eimco engineers consult with you on your filtration problem. For years they have made it their business — through research — to offer better liquid-solid separation through filtration.

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B-209

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ALL THE COPPER, NICKEL AND COBALT COMPOUNDS listed above are manufactured by Baker in tonnage quantities to exacting standards. They are *economical to buy* and *economical to use.*

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chemicals do you need for production use?

Cupric Acetate Reagent
Cupric Carbonate Reagent
Cupric Chloride Reagent and Purified
Cupric Nitrate Reagent, Purified, Tech.
Cupric Oxide Reagent Pdr. and Reagent Wire
Cupric Sulfate Reagent, Fine Crystal
Cupric Sulfate Reagent, Anhydrous Powder
Cuprous Chloride Reagent Powder

USES

- Ingredients of catalyst mixtures
- Ingredients of mineral supplements
- Textile mordants
- Photographic fixers
- De-nitrating agents
- Ingredients of fungicides and insecticides
- Coloring agents for glass and ceramics
- Process materials in metallurgical operations

Analytical Determinations	Cupric Chloride: Reagent Crystal Specif. Limit	Cupric Chloride: Purified Crystal Typical Analysis	Cupric Nitrate: Reagent Crystal Specif. Limit	Cupric Nitrate: Purified Crystal Typical Analysis	Cupric Nitrate: Technical Crystal Typical Analysis	Cupric Oxide: Reagent Powder Specif. Limit	Cupric Oxide: Reagent Wire Specif. Limit	Cupric Sulfate: Reagent Fine Crystal Specif. Limit
Typical Copper Content (as Cu)	37.1 %	36.9 %	26.7 %	26.5%	26.2 %	79.7 %	–	25.4 %
Water Insolubles	0.010%	0.02%	0.010%	0.02%	0.14%	–	–	0.005%
Acid Insolubles	–	–	–	–	–	0.005%	–	–
pH of 5% Solution	–	–	3.0-4.5	–	–	–	–	–
Carbon compounds (as C)	–	–	–	–	–	0.010%	0.005%	–
Chloride (Cl)	–	–	0.002%	–	–	0.005%	–	0.001%
Nitrogen compounds (as N)	–	–	–	–	–	0.002%	0.001%	0.001%
Nitrate (NO_3)	0.005%	–	–	–	–	–	–	–
Subst. not ppt. by H_2O (as SO_4)	0.10 %	0.15%	0.005%	0.07%	0.15%	0.20 %	–	0.10 %
Iron (Fe)	0.005%	–	0.005%	–	–	–	–	0.003%
$(NH_4)_2S$ Metals other than Fe (as Ni)	–	–	0.005%	0.05%	–	–	–	0.005%
Lead (Pb)	–	–	0.001%	–	–	–	–	–
Sulfate (SO_4)	0.005%	–	0.005%	–	–	–	–	–
Sulfur Compounds (as SO_4)	–	–	–	–	–	0.005% Passes A.C.S. Test	0.004%	–
Free Alkali	–	–	–	–	–		–	–
Ammonium hydroxide ppt.	–	–	–	–	–	0.10 %	–	–

Nickelous Acetate Reagent
Nickelous Ammon. Sulfate Reagent
Nickelous Carbonate Reagent
Nickelous Chloride Reagent and Purified
Nickelous Nitrate Reagent and Purified
Nickel Oxide Black Reagent
Nickel Oxide Green Reagent
Nickelous Sulfate Reagent

USES

- Ingredients of catalyst mixtures
- Textile mordants
- Reagent in metallized dye preparation
- Agents in nickel plating
- Agents in photo-engraving operations
- Process materials in paint and ceramic manufacture
- Agents in ferrite manufacture

Analytical Determinations	Nickelous Chloride: Reagent Crystal Specif. Limit	Nickelous Chloride: Purified Crystal Typical Analysis	Nickelous Nitrate: Reagent Crystal Specif. Limit	Nickelous Nitrate: Purified Crystal Typical Analysis
Typical Nickel Content (as Ni)	24.6 %	24.2 %	20.1 %	20.0 %
Water Insolubles	0.005%	0.06 %	0.005 %	0.05%
Acid Insolubles	–	–	–	–
pH of 5% Solution	4.5-6.5	–	3.5-5.5	–
Chloride (Cl)	–	–	0.001 %	–
Nitrogen Compounds (as N)	0.005%	–	–	–
Ammonium (NH_4)	–	–	0.10 %	–
Sulfate (SO_4)	0.005%	–	0.002 %	–
Lead (Pb)	0.005%	–	0.003 %	–
Copper (Cu)	0.002%	0.005%	0.0005%	–
Cobalt (Co)	0.20 %	–	0.05 %	0.10%
Iron (Fe)	0.002%	0.04 %	0.001 %	0.06%
Zinc (Zn)	0.010%	–	0.010 %	–
Alkalies & Earths (as SO_4)	0.20%	0.16 %	0.10 %	0.15%

Cobalt Acetate Reagent
Cobalt Carbonate Reagent
Cobalt Chloride Reagent and Purified
Cobalt Nitrate Reagent and Purified
Cobalt Oxide Reagent
Cobalt Sulfate Reagent

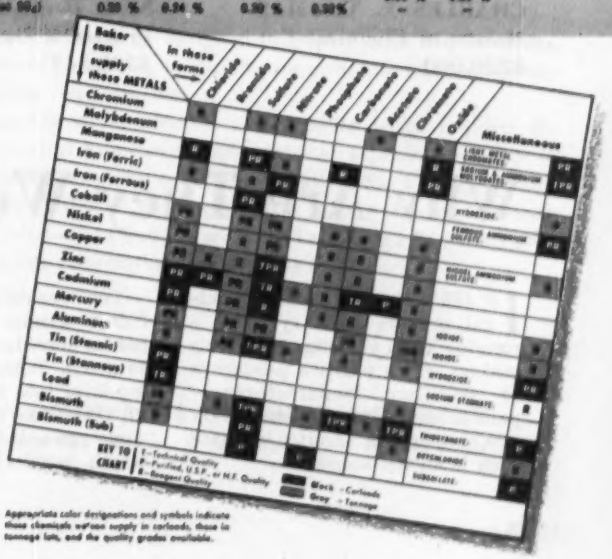
USES

- Driers in paints and varnishes
- Ingredients of catalyst mixtures
- Ingredients of mineral supplements
- Source of cobalt for alloys
- Source of cobalt for ceramics
- Binders in carbide tools
- Components of cermet thermistors

Analytical Determinations	Cobalt Chloride: Reagent Crystal Specif. Limit	Cobalt Chloride: Purified Crystal Typical Analysis	Cobalt Nitrate: Reagent Crystal Specif. Limit	Cobalt Nitrate: Purified Crystal Typical Analysis	Cobalt Oxide: Reagent Powder Specif. Limit	Cobalt Sulfate: Reagent Crystal Specif. Limit
Typical Cobalt Content (as Co)	24.8 %	24.3 %	20.2 %	19.8 %	73.0 %	20.7 %
Water Insolubles	0.010%	0.018%	0.010%	0.03%	–	0.010%
Acid Insolubles	–	–	–	–	0.030%	–
pH of 5% Solution	4.0-6.5	–	4.5-7.0	–	–	3.0-5.0
Chloride (Cl)	–	–	0.002%	–	0.010%	0.001%
Nitrogen Compounds (as N)	–	–	–	–	0.005%	–
Ammonium (NH_4)	0.005%	–	0.20 %	–	–	–
Nitrate (NO_3)	0.01 %	–	–	–	–	0.005%
Sulfate (SO_4)	0.005%	–	0.005%	–	0.10 %	–
Lead (Pb)	0.002%	–	0.002%	–	0.002%	0.002%
Copper (Cu)	0.002%	–	0.002%	–	0.020%	0.002%
Iron (Fe)	0.005%	0.002%	0.001%	0.05%	0.050%	0.001%
Nickel (Ni)	0.10 %	0.006%	0.15 %	0.15%	0.10 %	0.10 %
Zinc (Zn)	0.03 %	–	0.010%	–	0.010%	0.020%
Alkalies & Earths (as SO_4)	–	–	–	–	0.05 %	0.25 %
Subst. not ppt. by $(NH_4)_2S$ (as SO_4)	0.25 %	0.24 %	0.50 %	0.50%	–	–

The chart shows the wide variety of heavy metal compounds Baker supplies in tonnage quantities, and the quality grades available.

FREE REFERENCE FILE also contains availability charts of Baker Light Metal Compounds, Acids (Inorganic, Organic, Acid Anhydrides) and complete price schedules. For your copy send letter or postcard.



Appropriate color designations and symbols indicate those chemicals we can supply in carloads, those in tonnage lots, and the quality grades available.

J. T. Baker Chemical Co.

REAGENT · CHEMICAL · FINE · INDUSTRIAL

Phillipsburg, New Jersey

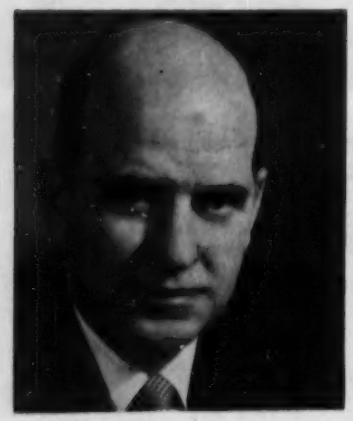
–for production use

Here are a few of last year's $100,000/yr. men in the chemical industry:

C. H. GREENEWALT
E. I. du Pont de Nemours Co.
$642,619

MORSE G. DIAL
Union Carbide & Carbon Corp.
$262,500

F. J. EMMERICH
Allied Chemical & Dye Corp.
$125,000



CHARLES A. THOMAS
Monsanto Chemical Co.
$220,000

NEIL H. McELROY
Procter & Gamble Co.
$320,317

JAMES HILL Jr.
Sterling Drug, Inc.
$151,454

Why Are They Worth So Much?

IN 1955, SEVERAL DOZEN chemical process industry firms—ranging from oil refiners to drug makers, from plastics producers to fertilizer manufacturers—paid at least one top officer $100,000 or more. A handful of these men is shown above.

You wouldn't be human if you didn't wonder why their companies consider these men worth so much. What is it about these top-level jobs that men who can fill them take title to such handsome rewards? This question is worth pondering whether you yearn for those rewards—and the duties entailed—or not.

It's the Vital Spot

The job at the top of any company's hierarchy, the job of the chief executive, is the most vital post in the firm. A poor per-

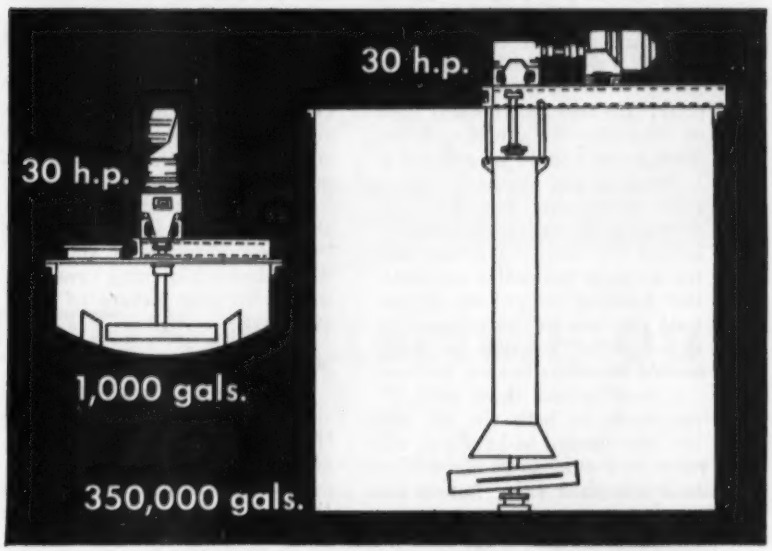
Turbo-Topics

TURBO-MIXER GENERAL AMERICAN TRADE MARK

TURBO-MIXER, a division of

GENERAL AMERICAN TRANSPORTATION CORPORATION

Power properly applied with TURBO on the job



High Viscosity Resin Dissolving Versus Low Density Slurry Blending.

- **ECONOMICAL FIRST COST**
- **MAXIMUM PRODUCTION EFFICIENCY**
- **LOWEST OPERATING AND MAINTENANCE COSTS**

In designing a mixer, service requirements determine the size and location of the impeller. But—it's the design of the impeller itself that determines effective power utilization.

Not only is every Turbo-Mixer designed to meet service requirements, but every Turbo-Mixer has the right impeller for optimum mixer efficiency with minimum power requirements.

The proper balance of mixer selection and impeller design requires the application of theoretical knowledge and practical experience—years of experience gained from successful operating installations. This knowledge and experience in the design of process industry mixers is your assurance of "headache free" production and lower costs in the long run with Turbo on the job. For complete information, call or write today.

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"A look at the job and at the man behind that $100,000 paycheck shows why."

formance by the man who fills that post can do the firm greater and more lasting damage than a bungled job anywhere down the line. This is simply because the decisions that logically fall to the chief executive are more far reaching and of greater importance to the company than decisions made by others in the firm.

From his perch at the top of the organization chart, the chief executive has the best view of the interplay among the many groups that make up the company. He also has the best view of the course the company is following—or should be following.

Since he has the best view in both directions, he's held responsible for calling the signals among the company groups and for keeping the entire organization heading toward the proper goal. No one in the company is in a better position to make needed decisions in such matters.

A look behind those $100,000 paychecks at both the job and the man needed to handle it will show why companies are willing to put such a price tag on his services.

The Job You Can't Describe

As J. Elliot Janney, a psychologist turned management consultant, points out in an article on company presidents,* it's virtually impossible to set down a definitive description of the job of the chief executive. Content, emphasis and impact of the job will vary as much with the personality of the man who holds it as with any other factor.

To further fog our lens and hinder our focusing on the top man and his job, there are cogent arguments for viewing the job of chief executive as being simply too big to be filled by any one man.

In his excellent book, "The Practice of Management," (Harper & Brothers, New York, 1954) management consultant Peter Drucker details this reasoning. Drucker notes that many successful companies actually do use a team of top executives to perform the duties of the post —although only one of the team members holds the actual title.

For our purposes we can define the chief executive's job as that job in a business organization that is charged with final responsibility for all basic decisions on the initiation, conduct and continuation of current and future operations.

In a given company the actual chief executive may be the president or he may be the board chairman, head of the executive committee, head of the finance committee or, as sometimes happens, one of the vice presidents. The chief executive may even be the team that Drucker urges. Whoever or whatever shoulders final decision-making responsibility fits our picture of chief executive.

Making the Plans

Activities of the chief executive typically break down into three categories: Planning, executing, appraising.

His first responsibility is to think through and develop the over-all objectives for the company. The basic decisions on the organization structure needed to attain these objectives are also his. Finally, he has to approve the plans that are developed to reach them.

Rarely are such plans simply brought to him for his imprimatur. Particularly when major moves are contemplated, the chief executive has likely contributed at every step of planning, from determining how and where to raise the money to setting the completion date for the project.

Doing and Reviewing

In the executing category, the chief executive's biggest job is communication. He has to make sure that his management people know the objectives of the firm and he has to insure that they keep him informed on what's being done to attain these goals. He has to ask the right questions of his executives that they know what's expected of them.

Akin to communication is the grooming of future managers for the business. It's part of the job of the chief executive to educate his managers. He should see that they have opportunities to increase their effectiveness, to prepare for future responsibilities. He arbitrates conflicts among them and helps them coordinate the activities of their individual groups.

Appraisal is a constant duty. Objectives, programs, personal need review with every new development. Often he may not do this personally, but he is charged with seeing that it is properly done. And when business-defining objectives, company-wide programs and top-executive personnel are involved, the bulk of this chore falls to him.

Being the Firm's Face

In addition, the chief executive has to function as "front man" for the company. He is expected to represent the company to its employees, stockholders and the general public.

This usually involves officiating at company social functions, answering questions and shaking hands at the annual stockholders' conclave, addressing management associations or similar groups, visiting plants and branch offices, meeting important customers, talking to security analysis, serving on committees in civic, charitable or educational groups and countless other time-eating chores.

It's a Lonely Job

But with all of these functions spilling over the typical chief executive's schedule, and with all the contacts with other people that such functions entail, loneliness is generally the lot of the top man.

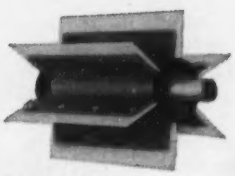
"Isolation of command" is the term the military use to describe this paradox. Try as he may to prevent it, a wall suddenly springs up between the chief executive and many of his former associates when he takes over the top job. He finds that he just can't be one of the boys again.

This isn't helped by the fact that words and actions of the

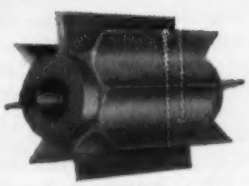
* *Harvard Business Review*, May-June 1952, p. 59.

LOCKS Air and Gas in

–FEEDS Materials out!

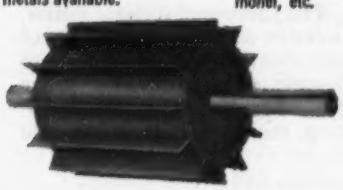


6-VANE ROTOR
with plastic, rubber, or other replaceable vanes.



12-VANE ROTOR
designed for use as a feeder, furnished with carbon steel cylinder and brass blades. Other metals available.

SOLID 8-VANE ROTOR
furnished in cast iron, bronze, stainless steel, monel, etc.



The MIKRO Rotary Airlock provides an ideal method of feeding free-flowing materials under pressure or vacuum, while sealing in air or gas from passing on with the material.

A precision-built rotary valve, the MIKRO Airlock continuously feeds materials from an upper chamber into a lower one by gravity. The vanes of its rotor provide a seal which prevents leakage of air or gas from the upper chamber into the lower chamber, or into the atmosphere.

Applications of the MIKRO Rotary Airlock are many and extremely varied. It can be used at the discharge of a pulverizer or a dust collector. It can also be used on the discharge of a blender or mixer to regulate the flow of material from the unit. It can likewise be used as a feeder to control the rate of flow from a storage bin or hopper, or as a feeding mechanism to a pulverizer, a pneumatic conveying system, mixer or blender.

The MIKRO Airlock is available for low or high pressure use, with capacities varying from 100 to 15,000 lbs. per hour depending upon rotor speed and density of material handled. Furnished with various types of rotors and vanes to meet specific requirements.

SEND FOR new MIKRO Rotary Airlock Bulletin

Mikro-D

PULVERIZING MACHINERY DIVISION
METALS DISINTEGRATING COMPANY, INC.
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PULVERIZING • AIR CONVEYING • DUST COLLECTING EQUIPMENT

"Most firms need at least one man ready to fit into the top job every decade or so."

chief executive carry a lot of weight. Naturally, this helps him get things done, but it can be a terrific burden since people in the organization, particularly those at lower management levels, often "read" meanings into the most casual words and actions of the top man.

Silly? Sure it is, but such misinterpretations are frequent. So even with his top officers the chief executive finds that he has to be careful of what he says and does. They tend to weigh every problem, every decision on the scale of their own interests.

The Backstop's Gone

In the lower echelons it's fairly easy to find somebody at your own level with whom you can talk over common problems. Or, if you're really stuck, you can seek advice from your boss. At the chief executive level there are no others, at least none within the company. And there isn't any boss to give advice either.

In a recent discussion of this aspect of the chief executive's job, *Business Week** quotes one fairly new president: "It's one thing to be the guy who votes on a proposition or who briefs the president before he makes a decision, it's something else again when you're the guy that's got to make the decision. Oh, sure, your assistants get the facts for you, but it's your neck if that decision turns out wrong."

And another: "The view from the president's office is a lot different than one from the window of a department. Decision-making was a cinch when I had a backstop. Now there's no backstop—and the decisions are more far-reaching."

They All Want Something

These aspects of his isolation may bother the chief executive, may make him take steps to bridge the gulf between his position and the rest of his organization. But one thing will hold him back: Too many people want things from him.

All his subordinates have read articles on how to sell their ideas to the boss. He knows that he needs their ideas, but he also knows that he has to be wary about being "sold." Most of his subordinates want to advance their position, and he's the one who can do it for them.

The chief executive is also apt to be a target for major customers hunting for better service or lower prices. This is particularly true in the small or "middle-size" firm.

Suppliers, too, court his attention. A word from him naturally carries weight with the purchasing department. And the supplier knows that this weight can push an order his way.

To the solicitor, the chief executive is a money-tree to be shaken for any need. As Dr. Janney puts it: "There is a cultural lag on the part of many individuals who still think of the company president in terms of the millionaire entrepreneur of a bygone generation who was able and willing to give princely endowments. They fail to realize that most are 'high-priced hired help whose take-home pay is very limited after taxes in relation to the position they are supposed to maintain.'"

Generally, all of these pressures are applied subtly—but constantly. The chief executive feels them in his social life as well at the office. They make his isolation a grim necessity. It's the only way he can get on with his work.

Need One Often

A recent study of some 460 companies in all fields* shows that about two-thirds changed presidents in the past 10 years. A third brought in a new president since 1950.

And, despite a fair number of exceptions, men who take on the top job aren't likely to remain there too long. Typically, they enter the post in their late fifties and with compulsory retirement plans, attractive pension programs and what not, they move out at 65.

This means that most firms need at least one man ready to fit into the top job every decade or so.

What Do They Look For?

What type of individual do companies look for when they need a chief executive?

Usually, he's well into middle age, has a college degree (likely a technical degree), has held about a dozen different job titles in his career, has had several years seasoning in a top-level executive post, likes people and, above all, can get things done—done right and on time.

His key quality is almost sure to be a knack for encouraging co-workers to greater efforts. Many, if not most, of his decisions have to be made on the basis of information abstracted for him by his subordinates. Since responsibility for the decision is his alone, the chief executive needs the best efforts of his subordinates to be successful.

No matter how skilled he is at planting, deciding or reviewing his company's progress, if he can't spur his co-workers to do the best job that's possible, he's under a handicap that won't easily be licked.

What Are the Rewards?

The responsibilities, duties, isolation and the frustrations of the chief executive's job are literally on only one side of the coin. As we noted at the beginning, the rewards paid men who

* June 9, 1956, p. 118.

* *Business Week*, June 9, 1956, p. 110.

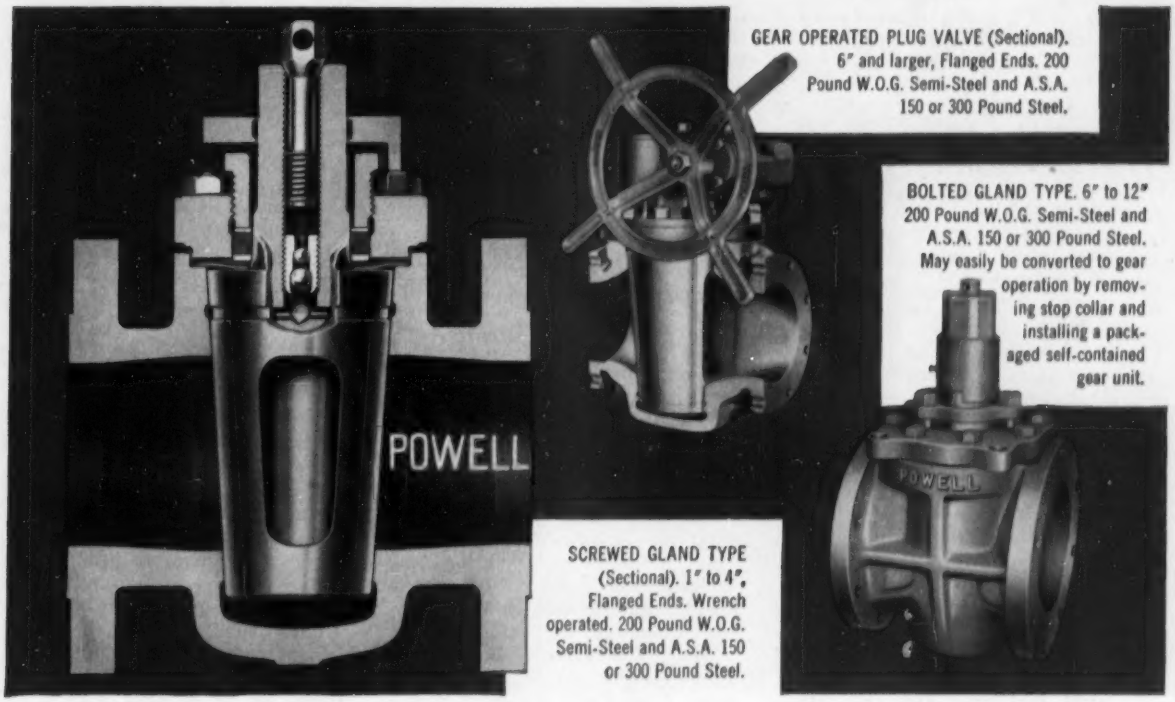
Next Month: What New Books Are Worth Your Time?

This year has produced a fine crop of helpful books for the engineer interested in growing into management. In December, You & Your Job will look over this harvest with you. You'll see which are worth reading and which can be passed by and what's good and not-so-good in each. This winnowing will help you set up a reading program that can make you better informed, better prepared for promotion.

POWELL

Lubricated Plug

VALVES



GEAR OPERATED PLUG VALVE (Sectional). 6" and larger, Flanged Ends. 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel.

BOLTED GLAND TYPE. 6" to 12" 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel. May easily be converted to gear operation by removing stop collar and installing a packaged self-contained gear unit.

SCREWED GLAND TYPE (Sectional). 1" to 4", Flanged Ends. Wrench operated. 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel.

Powell Lubricated Plug Valves maintain our 110-year tradition of quality and precision. Only the finest available materials are used. And painstaking quality control is rigidly enforced through each and every step of manufacture.

Features include quick and positive operation—just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

Valve users who want one source of supply for lubricated plug as well as all types of bronze, iron, steel and corrosion-resistant valves will want full details on Powell Lubricated Plug Valves.

Available in Steel and Semi-Steel through distributors in principal cities. If none is located near you—or if you need help on valve problems—write direct to

PERFORMANCE PV VERIFIED

BRONZE, IRON, STEEL AND CORROSION-RESISTANT VALVES

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

The source of supply for all valve needs!

can handle this job are often pretty impressive—at least they're impressive before taxes.

A bigger income is only one of the rewards, albeit the only tangible one. Greater scope of work, more freedom of action and enhanced prestige are also important.

Opportunities to launch new ideas and to observe and take part in the development of other management men, less red tape to get in the way of his movements and to thwart his ideas, the power and trappings of the job itself are all sources of gratification to the chief executive.

STUDY JOB CONTENT

. . . *To Free Engineers*

Do you feel that you spend too much time doing routine, subprofessional work? Many engineers can point to a score of tasks that they have to do which could adequately be done by a non-engineer working under proper supervision.

Companies, too, have recognized this, but until recently few have done anything about it. Now, the real scarcity of inexperienced engineers and the relatively high salaries they command are forcing companies to give this problem serious study and to take steps toward solving it.

One solution involves the technician. These graduates of technical institutes and apprentice programs have demonstrated their worth many times. It is estimated that some 40,000 to 50,000 engineering technicians are needed annually. But less than 4,000 graduated from technical institutes last year. Though enrollments are up and more graduates are expected in the coming year, the demand, too, is expected to increase.

Salaries for these technicians start at about $375-390 per mo. —not too much below that paid for a BS engineer fresh from college.

Another solution, used by DuPont and a number of other chemical firms, relieves the engineer of many of his clerical duties by providing telephone answering, dictation and typing services. Engineers in supervisory jobs are sometimes assigned non-technical administrative assistants to help with such chores as preparing budgets, assigning help to other engineers, keeping track of vacation time and other paper work.

These and similar measures have met with near-unanimous applause from engineer and company alike. One engineer summed up the feeling of a good many others when he told us: "If it weren't for the help I get from my two technicians and the clerical services the company gives me, about a third of the work I do just wouldn't get done. Besides I feel like I'm doing an important job when the company give me help. I've worked in places where I was just a number to management, here I'm not."

RESPONSIBILITY

. . . *Sans Authority*

"How can we get our foremen to do a better job?" This old chestnut has been discussed and debated at management meetings since the building of the pyramids—with little apparent success. But a recent study of the American Management Association's Supervisory Development Service indicates that the answer may be a simple "Let them."

The AMA group found that many companies simply expect more from their foremen that they're willing to let them do. This paradox results from a frequent failure to give these men authority commensurate with their responsibility.

Here's a typical finding from the 66-company study: More than 80% expect foremen to discipline employees but less than 50% permit them to demote or discharge for cause and only about 35% allow foremen to award merit raises.

Except in the handling of employee grievances, an area in which most firms do grant him the needed powers, the forman's authority generally lags far behind the responsibilities assigned him. Rare, too, are the firms that let him participate in planning the programs he's expected to carry out.

COLLEGE CRISIS

. . . *Too Many and Too Few*

The country's engineering educators have a tough problem. Faced with a doubling of engineering enrollment in the next decade, they also have to contend with staff losses to industry.

Earlier last summer, at the annual meeting of the American Society of Engineering Educators at Ames, Iowa, faculty heads heard the University of Illinois' Ross J. Martin predict that fall enrollments will probably climb from last year's 243,390 to 486,000 in 1967. In 1969, Martin reckoned, the nation will have over half a million engineering students.

Martin also warned them that his estimates may well turn out to be conservative, since he assumed that the percentage of the population in the 18-21-year-old group who enroll in college will remain constant at 34%. Actually the percentage has been steadily rising since 1950.

Rising enrollments and their attendant problems—lack of funds, classroom space and living space—need only keep the deans up half the night, however, since they have another problem to worry about till morning. A two-year study of the migration of faculty members to and from industry reveals a net loss to the schools of 3.2%.

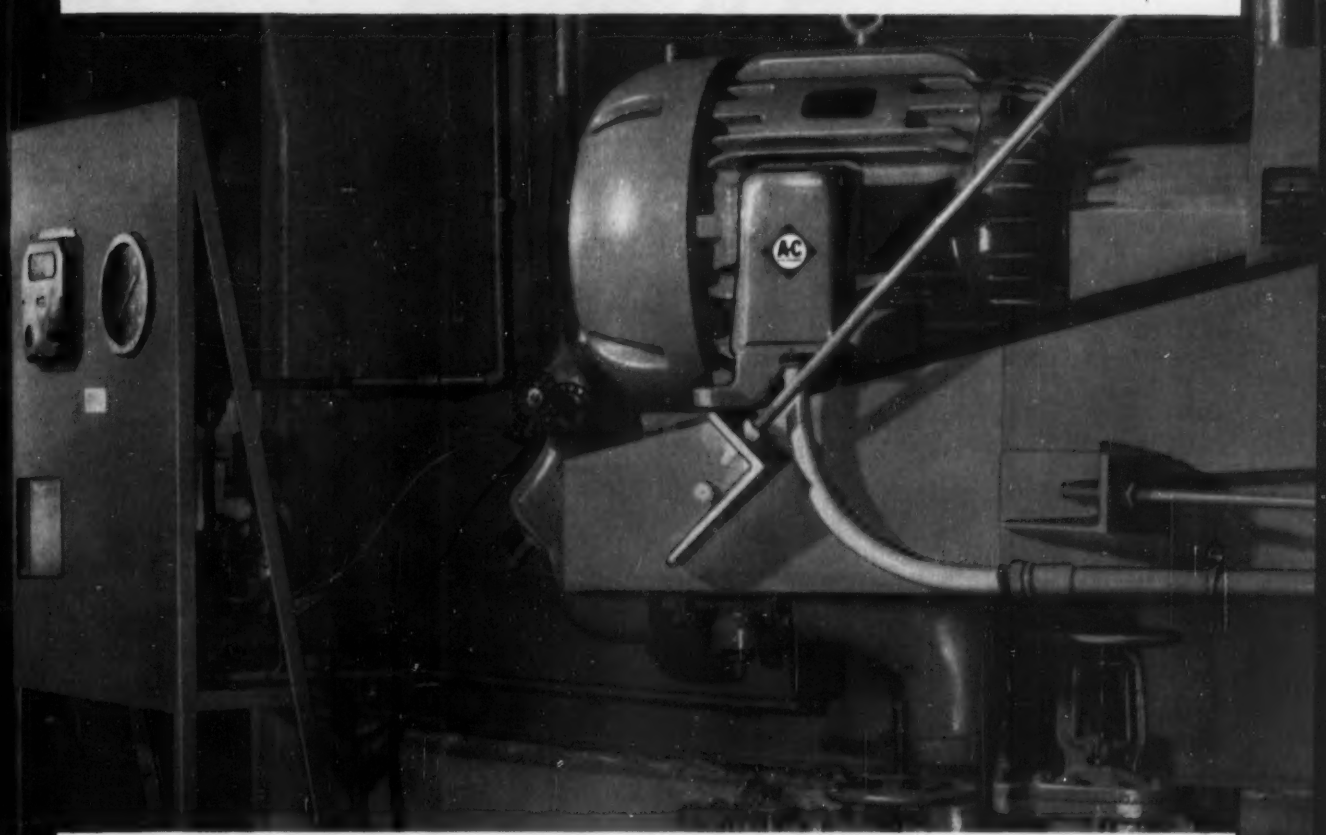
Based on 93 colleges with a total of 126,000 engineering students, the study showed that in the 1954-55 and 1955-56 school years 324 men left industry for the campus while 495 headed in the opposite direction. This left the schools with a net loss of 171 trained men.

As you've probably guessed, the salary differential was the chief reason given for the loss. About 80% of the schools called it the primary factor.

This fall the colleges report that they'll have to find some 120 professors, 200 associate professors, 450 assistant professors and 530 instructors. And, since practically all of these new men must come from industry, their prospects aren't bright.

For the chemical industry...

There's MORE continuous processing with Allis-Chalmers chemical MOTORS



Maximum protection against moisture, acid, alkali and heat is built into the Allis-Chalmers line of chemical motors. This results in fewer motor stoppages, uninterrupted processing, and more profitable plant operation.

Special safeguards against breakdowns are standard on Allis-Chalmers chemical motors:

1. All exposed components are of cast iron.
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3. Stator gets *five* dips-and-bakes in extra-insulating varnish . . . followed by two coatings of enamel.

Find out more about the "MORE" in Allis-Chalmers motors by contacting your nearby A-C office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

For Fast Delivery, check Allis-Chalmers first! Chemical motors are available in all standard enclosures. Shown here is a totally-enclosed model powering an agitator in a midwestern chemical plant.

ALLIS-CHALMERS

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from gas mantles to nuclear fuels...

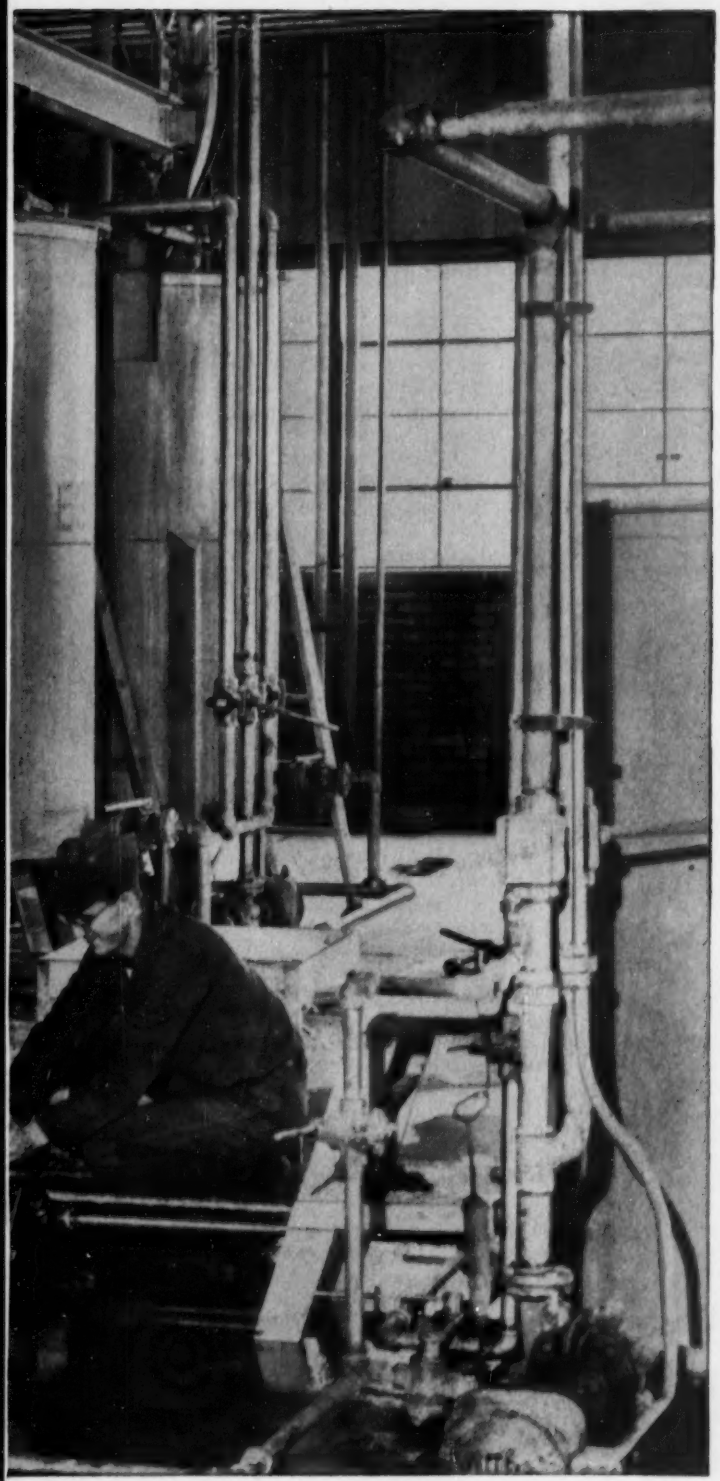
Lindsay relies on Stainless Steel

Thorium sludge is refined in these Stainless Steel filters. It is now a thorium nitrate-nitric acid solution.

USS

UNITED STATES STEEL

to process corrosive rare earth solutions



LINDSAY CHEMICAL COMPANY started to manufacture gas lamp mantles in 1902—using thorium nitrate obtained from monazite sand. The atomic energy program changed things in a hurry, and today 95% of Lindsay's production is devoted to rare earth and thorium chemicals.

Rare earth processing requires lots of nitric, sulfuric and phosphoric acids. Just *handling* these corrosive acids was a big problem until the introduction of Stainless Steel, and today this valuable metal is widely used at Lindsay for piping, valves, pumps, tanks, centrifuges and filters. No other material can do the job so well.

Nothing can equal Stainless Steel for its *combination* of properties: corrosion resistance, surface smoothness and density, strength and ease of fabrication. Think of Stainless when you design. Think of *USS* Stainless when you buy.

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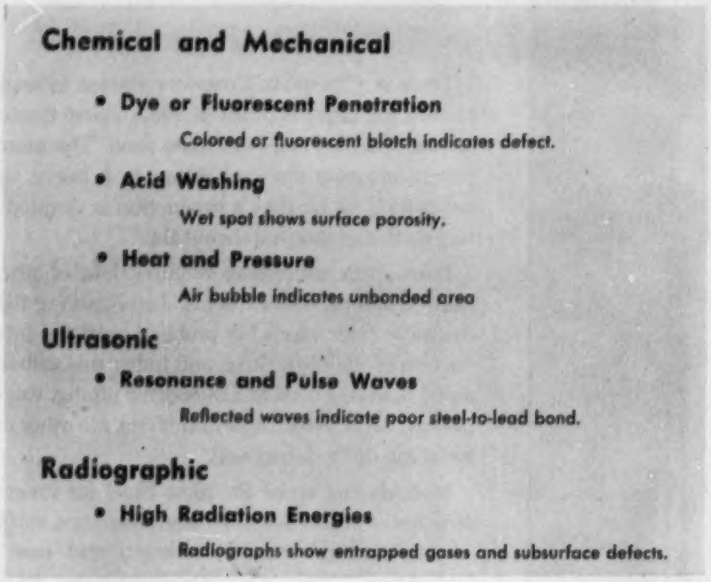
AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

From the filters, solution goes to these Stainless Steel steam-jacketed kettles. Note the Stainless hoods and panels.

USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS


Chemical and Mechanical
• Dye or Fluorescent Penetration
Colored or fluorescent blotch indicates defect.
• Acid Washing
Wet spot shows surface porosity.
• Heat and Pressure
Air bubble indicates unbonded area
Ultrasonic
• Resonance and Pulse Waves
Reflected waves indicate poor steel-to-lead bond.
Radiographic
• High Radiation Energies
Radiographs show entrapped gases and subsurface defects.

Latest Methods for . . .

Inspecting Lead Linings

Life may be extended through proper inspection and testing. More rigorous operating conditions make trouble-free installations more vital than ever.

KEMPTON H. ROLL, Lead Industries Assn., New York, N. Y.*

More rigorous operating conditions involving higher pressures, higher temperatures and higher corrosive concentrations are acknowledged trends in the chemical process industries. All exerting their influence on the choice of materials as well as methods of construction. They have helped focus attention on the need for more exacting inspection and testing techniques for processing equipment.

Lead is a common material of chemical construction and has been no exception to these trends. As a result, a number of methods have been developed for inspecting and testing sheet lead linings and bonded or lead clad linings.

Methods presented here are actually being used—in some cases by the fabricators of the equipment, and in others by the users.

Lead-protected chemical processing vessels are normally inspected for the presence of pinholes or porosity in welded seams on sheet lead linings; hairline cracks either in the weld or the sheet resulting from fatigue or stress corrosion; and pinholes, inclusions, or bond discontinuities in the case of clad vessels.

Defects falling into any of the above classifications, while they may not penetrate the lining completely, do form a potential trouble spot which may shorten the lining's expected life—a problem that can be minimized through the use of proper inspection and testing.

* Meet your author, p. 416.

Testing Procedures—Sheet Linings

Sheet lead-lined vessels generally consist of a steel, wood or concrete vessel or shell lined internally with sheet lead. Thickness depends on the type and conditions of service. Lead less than ⅛ in. (8-lb.) is rarely used in handling corrosives.

Lead is supported at the top by lapping over a flange, and on the inside by sheet lead-covered steel straps bolted through the lining to the outside. Presence and number of straps depend on the size of the vessel.

Joints in the lead are welded by a lead "burner" using a fine flamed oxy-hydrogen or acetylene torch, no flux and no dissimilar metals. The lead is merely melted and flowed together with any additional metal supplied from a bar of lead of the same composition.

After completion of a new installation or extensive repairs on an old lining, the seams are carefully checked visually and all obvious defects corrected.

If it is necessary to check the soundness of a lead weld (such as on butt joints) to determine the depth of fusion, a section of the seam can be trepanned with a trepanning drill to obtain a cross section. This technique has also been used on a bonded lining to check the nature of the bond and the thickness of the lining.

In either case, however, the test is destructive. Radiographic techniques might provide a more effective and, at the same time, a non-destructive test for weld soundness. More will be said about this later.

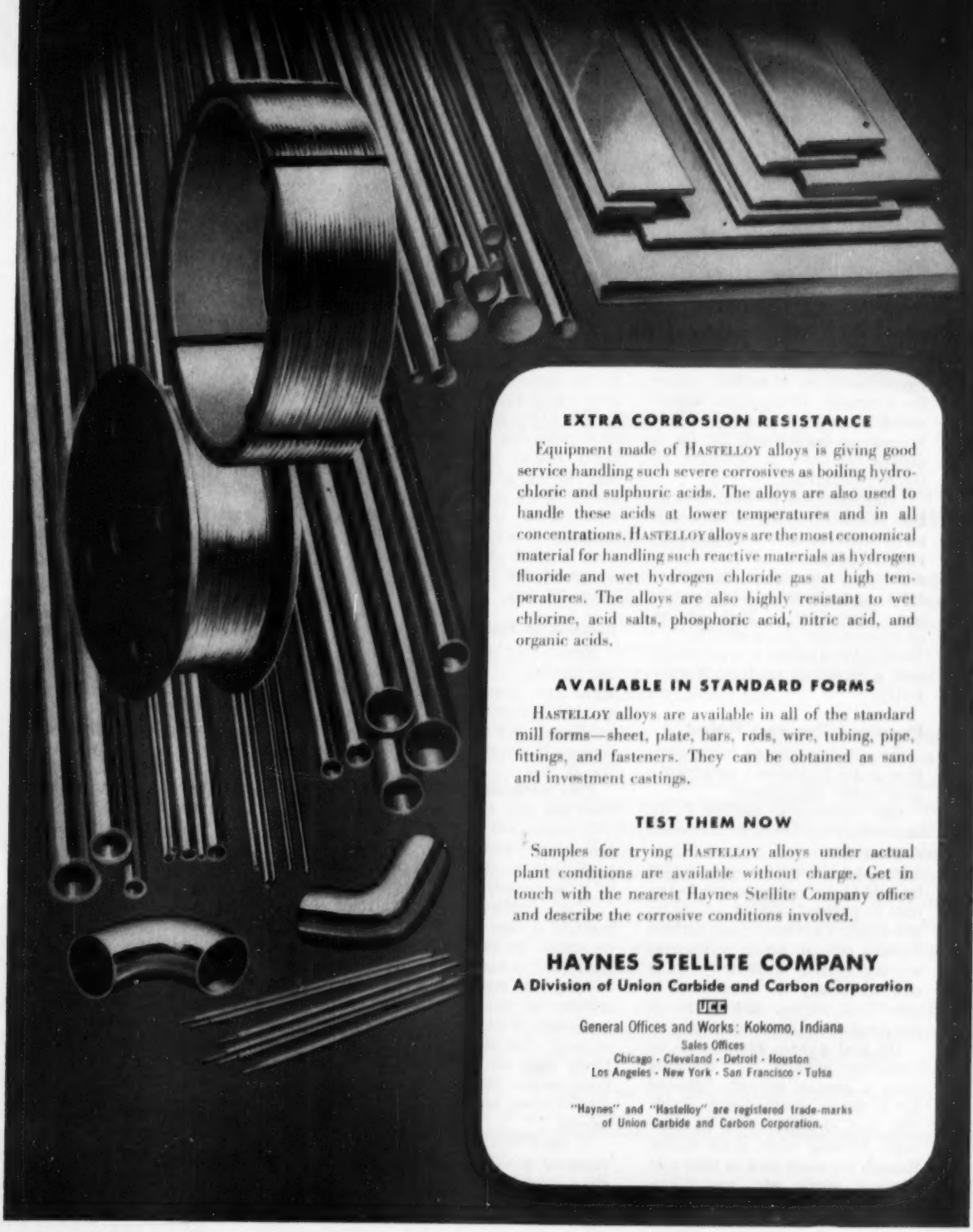
For closer and more exacting examination of lead welds, a fluorescent or dye penetrant may be used. This method enables the inspector to examine large areas more rapidly and accurately than is otherwise possible.

The penetrant method is based on the fact that tiny cracks or pores will absorb certain chemicals by capillary action. After cleaning off the excess, the chemical remaining in the imperfections can be "developed" or brought to the surface. Here it

HASTELLOY Alloys in Convenient Forms

Trade-Mark

...for Superior Corrosion Resistance



EXTRA CORROSION RESISTANCE

Equipment made of HASTELLOY alloys is giving good service handling such severe corrosives as boiling hydrochloric and sulphuric acids. The alloys are also used to handle these acids at lower temperatures and in all concentrations. HASTELLOY alloys are the most economical material for handling such reactive materials as hydrogen fluoride and wet hydrogen chloride gas at high temperatures. The alloys are also highly resistant to wet chlorine, acid salts, phosphoric acid, nitric acid, and organic acids.

AVAILABLE IN STANDARD FORMS

HASTELLOY alloys are available in all of the standard mill forms—sheet, plate, bars, rods, wire, tubing, pipe, fittings, and fasteners. They can be obtained as sand and investment castings.

TEST THEM NOW

Samples for trying HASTELLOY alloys under actual plant conditions are available without charge. Get in touch with the nearest Haynes Stellite Company office and describe the corrosive conditions involved.

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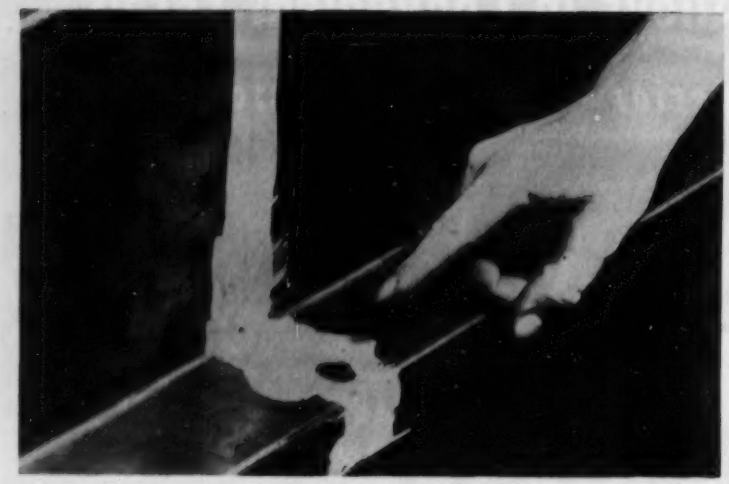


COLORED BLOTCH produced by dye reveals weld defect. (Magnaflux)

may readily be identified either by a bright glow under ultraviolet light in the case of the fluorescent penetrant, or by a distinctive color in the case of the dye penetrant.

Interpretation of each indication is all-important. Practically all procedures involving the fabrication of lead result in the possibility of confusion between a defect and a simple surface marking. Therefore, a high degree of discernment must exist to differentiate between a true defect and a harmless surface irregularity.

Fluorescent Penetrant Method

Preparation of lead for inspection using fluorescent penetrants is of prime importance.

One successful method is to sand-blast the surface to remove surface films and ragged edges. The sand-blasting nozzle should be held at a constant angle to the lead to prevent calking action by the blast. This may close certain defects which would otherwise appear during inspection. It is not necessary to sand-blast a new lead lining, but thorough cleaning is still necessary.

Oil and grease films must be removed—usually by washing with a grease solvent, followed by a warm soapy-water wash. The last cleaning step is thorough rinsing with clean water. Reason for such care is that oils, greases, soaps, etc., are inherently fluorescent. When removal is incomplete, false indications may show up during the latter stages of inspection.

A generous amount of penetrant should be applied to the lead lining either by brush or spray. More penetrant is needed with lead than with other metals. However, the soaking time is much shorter. At normal temperatures this will be from 12 to 20 min.

Removal of Penetrant

Removal of the penetrant from the surface is the most critical step. It should be removed quickly, since it will become hardened and more difficult to remove if allowed to soak beyond the 20 min.

Two methods of removal most used are (1) sand blasting, and (2) water-washing with either cold or hot water. The latter is preferred, especially in the case of large vessels.

The problem with either method is that just enough sand or water to remove the excess penetrant is needed. Any amount beyond that may reduce the sensitivity of the final inspection, especially if hot water or steam is used. For example, it is very likely that all of the penetrant from larger defects may be removed when washing is done in excess.

If sand blasting is used, a developing powder is not required since sand leaves a fine powdery film on the lead.

When water washing is used, the lead must be allowed to air dry before application of a developing powder. The powder acts as a blotting material, drawing the penetrating oil from the defect to the surface where it can be observed.

Interpretation of results is largely dependent on the experience and judgment of the inspector. It is the most important single criterion of good inspection. Training material, schools, and on-the-job training are available.

Some defects are readily distinguished, while other indications are difficult to interpret. These usually require the assistance of a lead burner who probes the areas with a torch. This will quickly determine whether the defect is a true flaw or not.

It must be understood that all indications revealed by this inspection method are not cracks or holes extending completely through the lead lining. In fact, by far the majority penetrate only partially. Nevertheless, they are important as potential trouble spots and should be corrected where they show up.

A limitation of the fluorescent method of inspection is that the operator must exclude as much light as possible to observe the fluorescence.

Dye Penetrant Method

A non-destructive method of testing lead linings and welds—requiring no electrical equipment—involves the use of a dye penetrant. Imperfections such as cracks, laps, cold shuts and porosity are indicated by lines, dots or blotches of a distinctive color on a white background, easly detected visually.

The process involves the use of three liquids: penetrant, cleaner and developer — which may be brushed on the surface to be inspected.

First the surface is cleaned. Then it is covered with the penetrant, which is left on for five or six min. One gallon of penetrant will cover an area of 1,000 to 3,000 sq. ft.

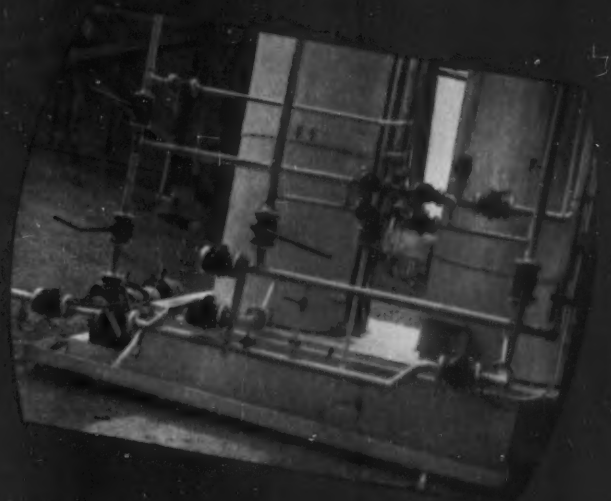
After removing the penetrant with the cleaner, the developer is applied. The colored penetrant will remain in any crevices until

"the answer..."

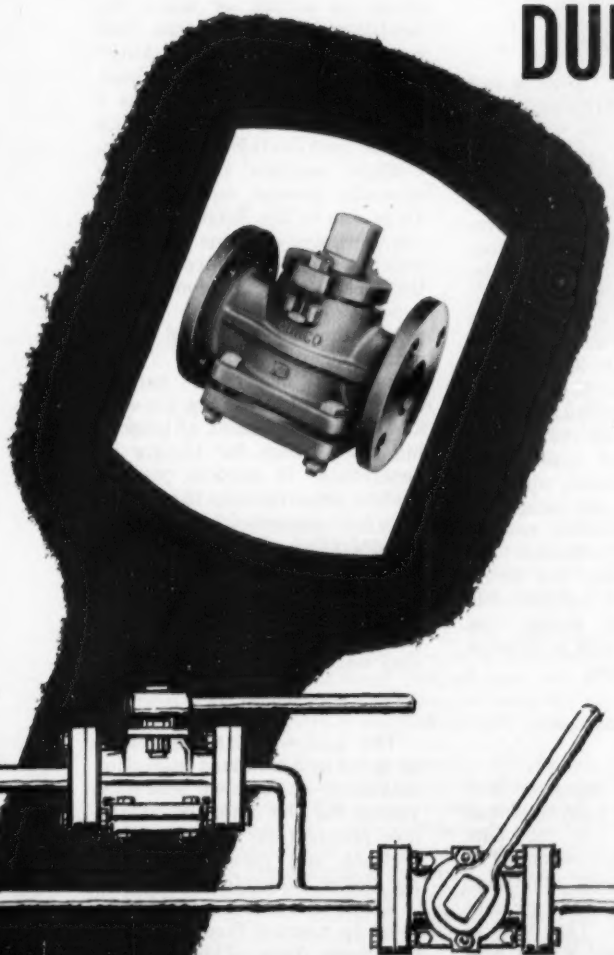
at Hercules Powder Company

HERCULES, CALIFORNIA

may be the one you've been looking for!



DURCO type F valves



For handling fuming red nitric acid, Durco Type F Valves have proved to be THE answer for Hercules.

On the manifold pictured above, there are nineteen Durco Type F Valves. These Durimet 20 valves have been in service more than three years . . . that is *trouble-free* service for more than three years. The pump is a D3RD Durcopump.

Hercules Powder Company is a leading producer of acids, anhydrous ammonia, and other ammonia products, cellulose products, resins, terpene chemicals, rosin and rosin derivatives, chlorinated products, industrial explosives, and many other materials. Since first using this type valve in their Hercules, California plant early in 1952, this Hercules plant has placed more than thirty repeat orders, in varying quantities, for Durco Type F Valves.

There are thousands of Durco Type F Valves in hundreds of applications, and we do not know of a single dissatisfied user.

Maybe we can solve a tough problem for you.

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

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ULTRASONIC testing for flaws—resonance Audigage. (Branson Inst.)

it is drawn to the surface by the action of the developer.

A colored line or blotch indicates a crack or cold shut. A series of dots in a line indicates a tight crack, cold shut or partially-welded lap. The photo shows how an imperfect weld would appear in the dye penetrant test.

The dye penetrant method has some limitations compared with the fluorescent penetrant, in that the actual surface of the lead is obscured by the developer. The test area cannot be studied alternately under either black or white light, as is the case with the fluorescent method. Also, it is perhaps less sensitive than the fluoresent penetrant in not showing up very minute flaws and in over-emphasizing others.

Other Tests for Sheet Linings

Several other inexpensive yet practical methods have been devised for the inspection and testing of sheet lead-lined equipment in the field—particularly for the detection of perforations.

One of these involves the use of kerosene containing dye. The dyed kerosene is pumped or poured between the sheet lead and the vessel shell, after sealing off weep holes or other areas that might allow the liquid to escape. The inside of the vessel can be filled with water to counteract the pressure of the kerosene and prevent bulging of the lining.

After removing the water and draining the kerosene through a weep hole, the surface of the lead inside the vessel is inspected for the presence of dyed kerosene, indicating a perforation. Repairs can then easily be made.

Another technique is still simpler. Freon-loaded air is pumped into the area between the shell and the lead lining. Using a halide torch, the presence of gas escaping through perforations can be readily detected and repairs made. The flange area, of course, must be sealed to prevent gas escape.

Carbon tetrachloride can be used in the same manner, by injecting it between the lining and testing with a halide torch. It effectively cuts sludge that might be present, and penetrates better than kerosene.

Testing Procedures—Bonded Linings

A bonded lead lining or lead cladding is simply a layer of lead anywhere from ¼-in. to 1-in. thick (usually ¼-in.)—bonded to steel, copper, or even aluminum so as to form a homogeneous metallic structure. This type of construction is used where heat transfer is important; where high temperature, thermal shock or vibration are encountered; or when the vessel operates under vacuum.

Most lead-clad steel equipment today is produced by variations of the pouring process. In this technique, the steel is prepared by first coating it with a thin film of lead or lead alloy. Molten lead is then poured on to a greater thickness than that specified for the completed vessel. This results in pouring such a large quantity that the lead covering the steel remains completely molten for some time after being applied.

At this point, steel rakes are used to push the lead back from the surface of the coated steel so that a full bond may be easily and visibly detected. Whenever the first coating has been burned from the steel, which would result in a lack of bond, the condition is easily seen and remedied. The "flame washing" method of removing excess lead, described later, also serves as a practical means for detecting lack of bond during manufacture.

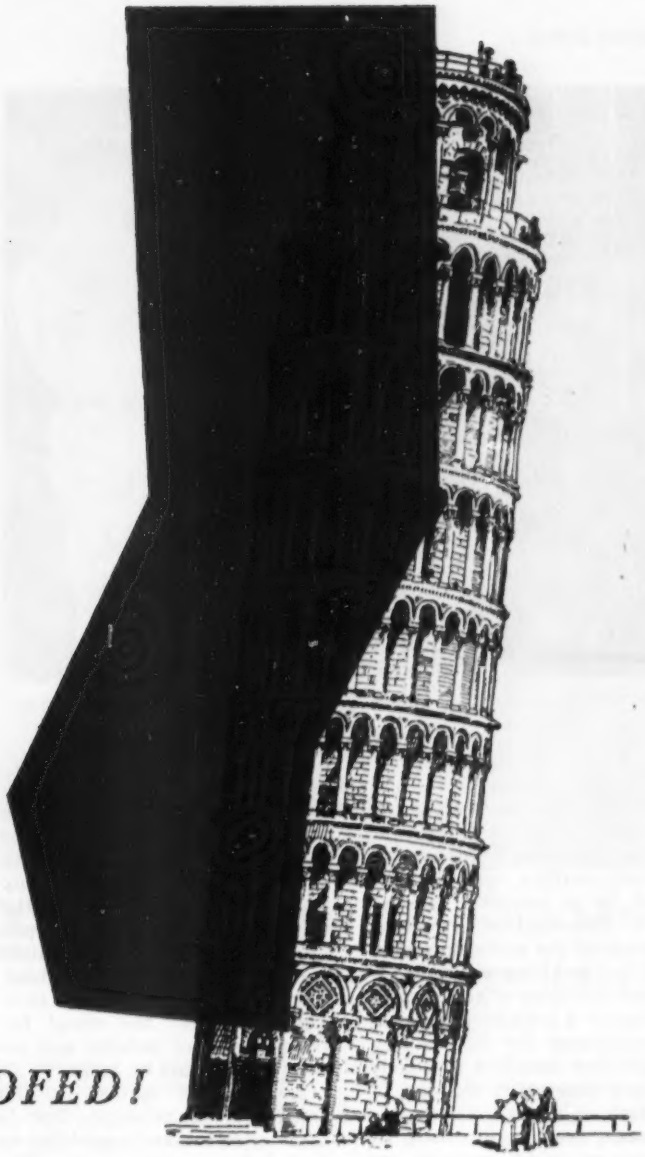
Slight surface irregularities normally present on lead claddings due to the finishing methods (scraping or flame washing) which are used to assure uniform thickness and freedom from drosses, make the use of the penetrant tests described above more difficult.

But, as mentioned earlier, light sand blasting can be used as an effective means of preparing the surface for testing by penetrants. It exposes possible surface imperfections that might have been concealed by the finishing operation. Furthermore, the light sand residue remaining on the surface after this treatment forms an excellent base for penetrants and makes the developing step unnecessary.

Acid Wash Test

The acid wash test has been accepted as a standard inspection technique on bonded lead-lined vessels for the detection of pinhole penetration, surface imperfections and porosity. It will not detect subsurface flaws.

First, the entire lead surface must be cleaned free of any oil or grease films. Then a dilute solution of hydrochloric acid (5 to 15% acid) is freely applied



SOMEBODY GOOFED!

Only by a freak of fortune does the leaning tower of Pisa still stand. A faulty foundation was not apparent until the structure was three stories high. It is believed the architects were then forced to compensate by adding weight to the opposite side to save the building.

Are you building corrosion problems into your plant structures and equipment that will inevitably have to be compensated for by tremendous replacement costs? Many of these costs can be eliminated *at the planning stage* by taking advantage of the services of an expert in the field of corrosion resistant coatings... the Amercoat Sales Engineer.

The Amercoat Sales Engineer is trained in the principle that in corrosion engineering, too, foundations are all-important. You can put this factory-trained man on your staff, so to speak, without cost or obligation. His advice will be truly objective since it is based on a knowledge of all types of protective coatings and more than 43,000 case histories in our files. You can be sure that the Amercoat coating he recommends, whether vinyl, phenolic, epoxy or any other type, will be the right one for *your* job, and the most economical on the basis of cost per square foot per year.

Therefore, to effect important economies in specifying protective coatings you are cordially invited to call on your Amercoat Sales Engineer... *right at the beginning.* He will analyze all pertinent data concerning your corrosion problems based on our nearly 20 years of corrosion control experience, and give you a comprehensive recommendation. In addition to recommending the proper coatings, he will assist you in writing complete specifications. However, this is not the full extent of his service: he will also be available for consultation at the job site to insure proper application.

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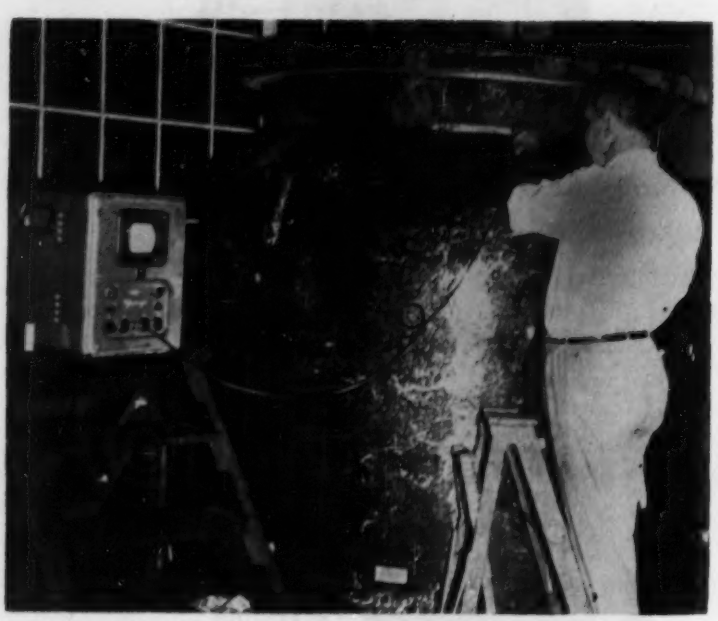


ULTRASONIC testing for flaws—pulse Reflectoscope. (Sperry Prod.)

to the entire surface by brushing or swabbing, and is allowed to remain for 12 to 24 hr.

Before cleaning off the acid, the lead surface may be examined by an inspector for wet spots or discoloration. Or better still, wash off the acid with water, let it dry, and then examine. A wet spot indicates either surface porosity or a pinhole which has not penetrated the lead. Rusty discoloration indicates a pinhole that has penetrated through to the steel.

Repairs are usually made on the wet spots by touching up with a lead burner's torch. Rust spot areas are removed and the steel cleaned so that new lead can be bonded. After rebonding at all rust spot indications, the acid wash test is repeated to give a final check.

Potassium ferricyanide solution may be used as a subsequent wash after the hydrochloric acid. Potassium ferricyanide reacts with iron salts to produce a distinctive Prussian blue color, which can be readily observed by the inspector.

Bond Discontinuities

Tests for bond discontinuities or un-bonded areas include these two methods now being used:

1. The completely bonded vessel is sealed and heated internally by means of an appropriate hot air blower system to raise the temperature of the shell to between 400 and 500 F. If any un-bonded areas are present, the thin film of air or gas trapped in this area expands and raises a conspicuous bubble in the lead. It is a simple matter, after cooling, to inspect the vessel for the presence of bubbles and re-bond these areas by hand.

2. A second method is the same test in principle, but is more effective and restricted to lead-clad pressure vessels. The vessel is heated by internal steam pressure to about 500 F. (680 psi. absolute) until thermal equilibrium is reached. At this point, the steam is turned off and pressure rapidly released from the vessel.

Air is then admitted, and the vessel is cooled and inspected for bubbles. If none is found, the test is repeated. After the second cycle, if none is found, the lining is accepted as 100% bonded. Any bubbles that do occur are removed and the areas re-bonded by hand.

This principle is also used in the manufacture of bonded linings when flame washing is used. This method, employing a "broom" of flame to melt off excess lead, heats the lead sufficiently to raise bubbles in any un-bonded areas. It also tends to remove those surface areas where dross inclusions would most likely be encountered.

The question of the degree of bond is a thorny one. There are any number of applications where 100% bond is by no means necessary, just as there are others where discontinuities could not be tolerated without courting premature failure.

For a consumer to specify arbitrarily a 90% bond, for example, would have little if any practical meaning to the fabricator of the vessel. It would have little bearing on anticipated performance, inasmuch as the allowable 10% bond discontinuity could be distributed over the entire surface of the vessel in the form of minute un-bonded areas. Or it could be concentrated in one area where, even though it represented only 10% of the total, it could easily be responsible for failure of the vessel.

Thus, it is imperative that the vendor and his customer agree beforehand on not only how much discontinuity can be tolerated, but also its location and area concentration.

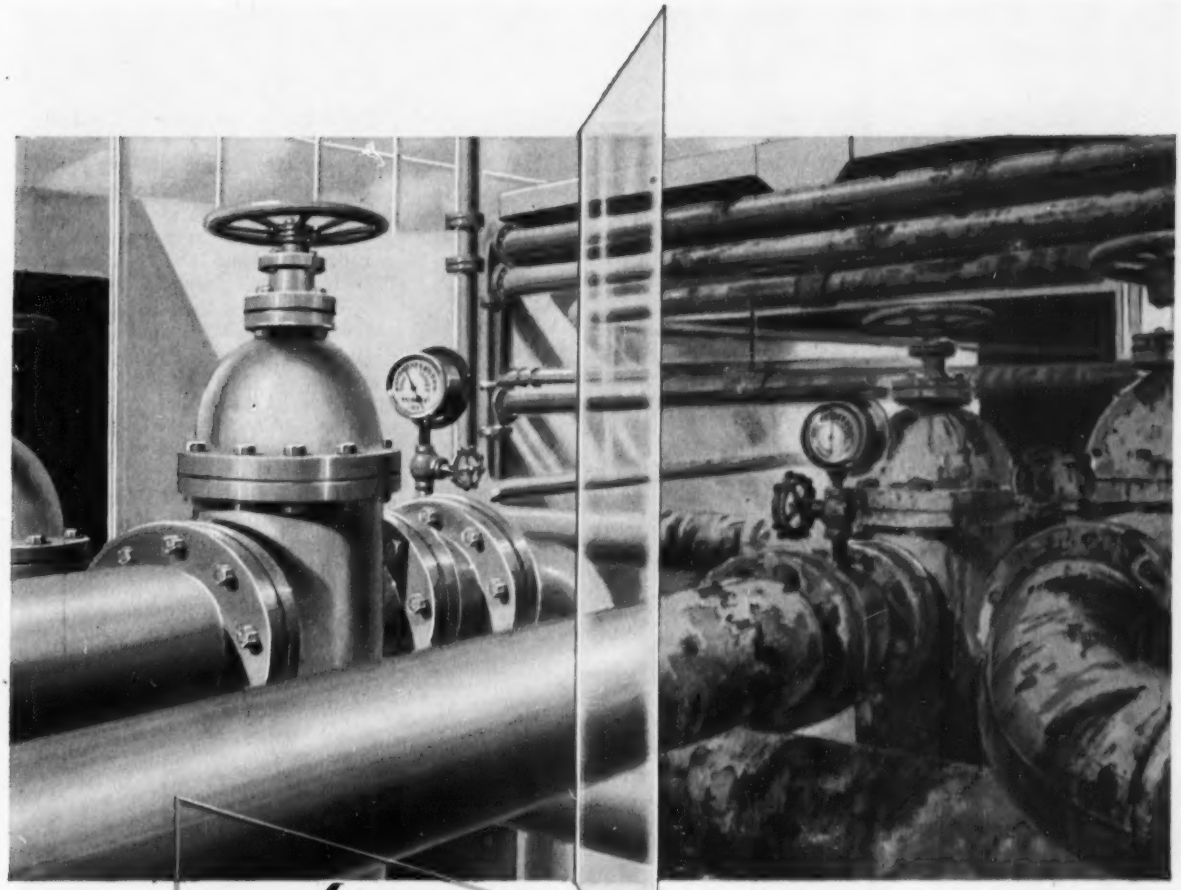
Ultrasonic Tests

Ultrasonic tests involving the transmission and reflection of ultrasonic waves lend themselves well to the location of unbonded areas and subsurface inclusions. They can also provide a simple non-destructive means for determining the lead thickness in bonded linings.

Two basic methods of ultrasonic inspection have been successfully used on bonded lead linings: (1) the "resonance" method employed by the Audigage, Sonizon and Sonigage, and (2) the "pulse" or "echo" method employed by the Reflectoscope.*

In the resonance method, the crystal head on the instrument transmits an ultrasonic wave into the metal. Waves reflected from the opposite surface are detected audibly in headphones (see photo) or on a calibrated

* Audigage manufactured by Branson Instruments, Inc., the Sonizon and Sonigage manufactured by the Magnaflux Corp., and the Reflectoscope manufactured by Sperry Products, Inc.



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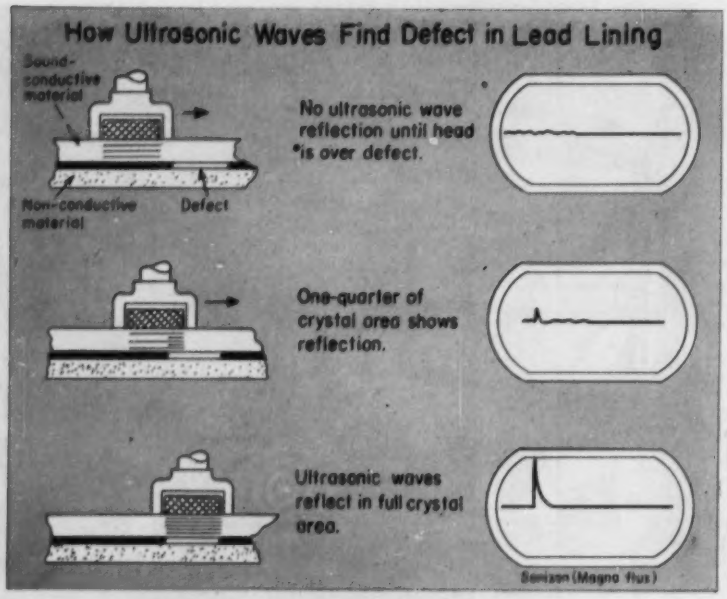
How Ultrasonic Waves Find Defect in Lead Lining
Sound-conductive material
Non-conductive material
Defect
No ultrasonic wave reflection until head is over defect.
One-quarter of crystal area shows reflection.
Ultrasonic waves reflect in full crystal area.
Sonizon (Magna flux)

cathode ray tube or a dial reading.

When lead is well bonded to steel, the waves are not reflected from the steel-lead interface. Consequently no signal is obtained. Small un-bonded areas (one-half of the crystal head size or smaller, or semi-bonded areas) may result in partial reflection of the waves from the interface, indicated by weak signals. Strong signals reveal a complete lack of bond, larger in area than the crystal head. The outline can be easily traced with the instrument.

In the pulse or echo method, vibrations are sent out through a similar crystal head. The pulse travels through the metal until it strikes a flaw and is reflected, while the rest of the waves travel on until they hit the opposite surface and are reflected. While the vibrations are alternately off, the crystal detects the reflected pulses and the time difference is converted electronically to readable indications of depth on a cathode ray tube (see photo).

Inspection by ultrasonics in most cases is made from the steel side. The steel surface must be free of weld spatter, heavy mill scale, deep gouges, etc. Light rusting, as found on the average plates in fabricator shops, is not objectionable.

The criterion is that the crystal head must make good contact with the surface. This may be accomplished by means of a water-soluble oil added to water —for work to be inspected in a downhand position. For vertical and overhead surfaces, a heavy oil (SAE 40) or light grease (vaseline) is used for good contact.

The surface to be inspected may be laid off in cross-hatched lines at approximately 6-in. centers, and checked at the intersections of the lines. If necessary, it may be tested over every square inch of surface area.

When using ultrasonic sound transmission, the acoustic properties of the materials involved have a direct bearing on the effectiveness of the technique. This is an advantage in the case of lead bonded to steel, because lead has poor sound transmission properties and therefore enhances the indication of bonded areas.

The drawing shows the type of reading using the resonance method that could be expected from a bond discontinuity in lead-clad steel.[1] When the crystal of the detector passes over an un-bonded area, a pip will be obtained whose height is proportional to the defect area.

With the pulse or echo method, the pips at or near both ends of the horizontal line on the face of the cathode ray tube are back reflections from the far and near surfaces. Defects show as pips of lesser height between the end reflections, and are located by their distance from the end pips.

When a reading is observed that would indicate lack of bond, the area is checked and the instrument is re-checked. Purpose is to determine if there is a lack of bond, or whether the instrument is out of calibration, or if there is foreign matter between the vessel and the crystal. If a definite area larger in diameter than say three times that of the crystal is established, the lining is sampled at this point to determine the degree of bond by "burning" or chipping away the lead. The area is then re-bonded by hand.

While the sensitivity of ultrasonic testing is high, it is not a panacea for production testing. It is most sensitive to voids normal to the beam such as a poor bond. A thin seam or crack having a direction parallel to the beam may be missed entirely.

Width and length of a defect can be measured but its depth cannot, unless three-dimensional probing is used. For this reason, selection of the proper wave length and technique used should be based on the size and type of flaw which harms operation of the vessel.

Use of a reference plate with known un-bonded areas and other flaws is recommended. It aids in adjusting the sensitivity of the instruments, and permits exact duplication at any future time.

Since the presence of other metals such as antimony or tin substantially effect the sound transmission of lead (pure lead is almost "dead" while 4% antimonial lead approaches steel as a sound transmitter), it is conceivable that ultrasonic devices might also be practical (though not as a primary function) to non-destructively and quickly detect the presence and perhaps approximate percentage of alloying constituents in lead equipment.

It has been suggested that peening an un-bonded lead area might alter the ultrasonic char-

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acteristics of the metal so as to give a false reading. To test this theory, a plate was prepared by a large user of bonded lead equipment with deliberately un-bonded areas. The plate was tested with a reflectoscope (pulse and echo system), and the un-bonded areas located and marked. The lead was then heated to about 100 F. and sledged with an 8-lb. hammer. Re-examination disclosed no change in the ultrasonic pattern whatsoever; the test does not give false peening readings.

Radiographic Testing

Because of its high density, lead is normally used as a material for shielding against radiation. It is possible, though, with the higher radiation energies commercially available today to obtain practical radiographs of the lead in lead-lined steel vessels.

Pioneering in this work, Skiba and Bracken[2] of the Esso Standard Oil Co. (Bayway refinery) and Detlor of Esso Research and Engineering Co. found that the radiographic inspection of lead linings is definitely feasible for locating entrapped gases and subsurface foreign inclusions not detectable by acid wash methods.

They obtained radiographs that were useful in locating the cause of failure in a lead and brick-lined steel vessel, consisting of $\frac{1}{16}$ in. lead bonded to $\frac{3}{4}$ in. steel and covered with $4\frac{1}{2}$ in. carbon brick. A 500 millicurie cobalt 60 source was employed at 86 in., with a 12-hr. exposure over an entire 24-in. manhole area.

Radiographic techniques are especially useful when testing brick-lined lead-clad vessels, as a means of avoiding the excessive expense and time loss involved in removing the brick lining. But proper and careful interpretation is especially important in this test. Radiographs are extremely sensitive and can easily lead to false indications of a faulty installation if they are not looked at critically.

In this respect, the use of stereo techniques to show depth of inclusions would aid considerably in interpreting the seriousness of flaws. Lack of bond, incidentally, is practically undetectable by radiographic methods.

Radiographic techniques might also provide a practical means for non-destructively testing lead welds for soundness, much as welds in steel are commonly checked.

Conclusion

All of the foregoing inspecting and testing techniques—penetrants, acid washes, ultrasonics and radiography—reflect an increasing concern with means of eliminating service failures and downtime in processing equipment.

It is a concern that is by no means restricted to lead linings. In fact all of the above techniques saw their beginning with other materials, and owe their present stage of development to this past experience.

In the case of lead-lined equipment, the conditions of the past were such that conventional fabricating techniques were sufficent to assure long and uninterrupted service life. But these conditions are changing today. The demand for operation at higher temperatures and pressures and under vacuum has thrown more emphasis on the need for effective and practical pre-service tests. Interest is now developing in lead claddings for radiation protection, where uniform density and continuous bond are all-important.

Most lead burning contractors and lead equipment fabricators have recognized this need, and have already begun using some of the tests described herein. At the same time, the users of lead equipment are themselves developing, applying and specifying tests—usually working hand-in-hand with the fabricator. The methods described perhaps do not represent the last word or even reflect the general practice, but they are proof of the attention that is now being given to testing lead linings.

The problem, however, is not so much that of finding defects as in deciding on practical standards of acceptance or rejection. We know, for example, that 100% bond in a bonded lead lining is not absolutely necessary for most applications. But how much bond discontinuity can be tolerated is a question still to be resolved.

The Lead Industries Assn. has attempted to compile as much information as is available and presentable within the limits of this article on the subject of testing and inspecting lead linings. It is hoped that lead fabricators, contractors and their customers will be better able to coordinate their efforts and to decide on criteria, to the ultimate advantage of all concerned.

Acknowledgment

The author is indebted for information and assistance in the preparation of this paper to the members of the Lead Industries Assn. and the following companies: Carbide and Carbon Chemical Co., South Charleston, W. Va.; E. I. duPont de Nemours & Co. engineering department; Freeport Sulphur Co.; Esso Engineering & Research Co.; Esso Standard Oil Co. (Baton Rouge refinery, Bayway refinery); Standard Oil Co. of California; Bransón Instruments, Inc.; Lubrication Co. of America; Magnaflux Corp.; Sperry Products, Inc.; Turco Products, Inc.

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1. Baumeister, G. B., "Production Testing of Bonded Materials with Ultrasonics, a Survey of Theory and Application." Paper presented before ASTM meeting, June 1954.
2. Skiba, W. and Bracken, V. P., "Radiographic Inspection of Lead Linings," paper No. 55-PET-15, ASME Conf., New Orleans, Sept. 25-28, 1955.

This article is based on a paper presented by the author before the recent Philadelphia meeting of the Society for Nondestructive Testing.

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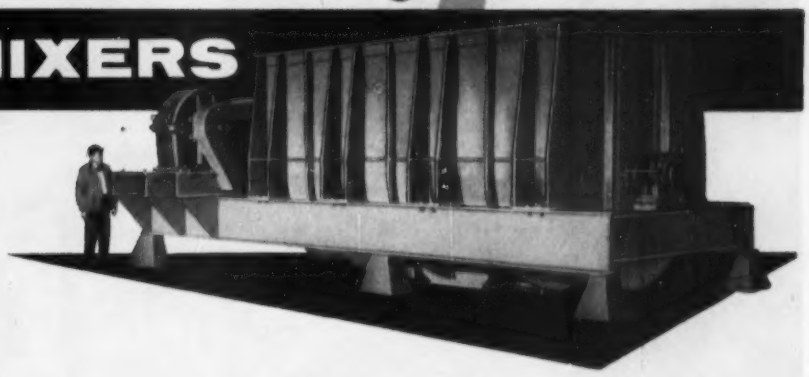

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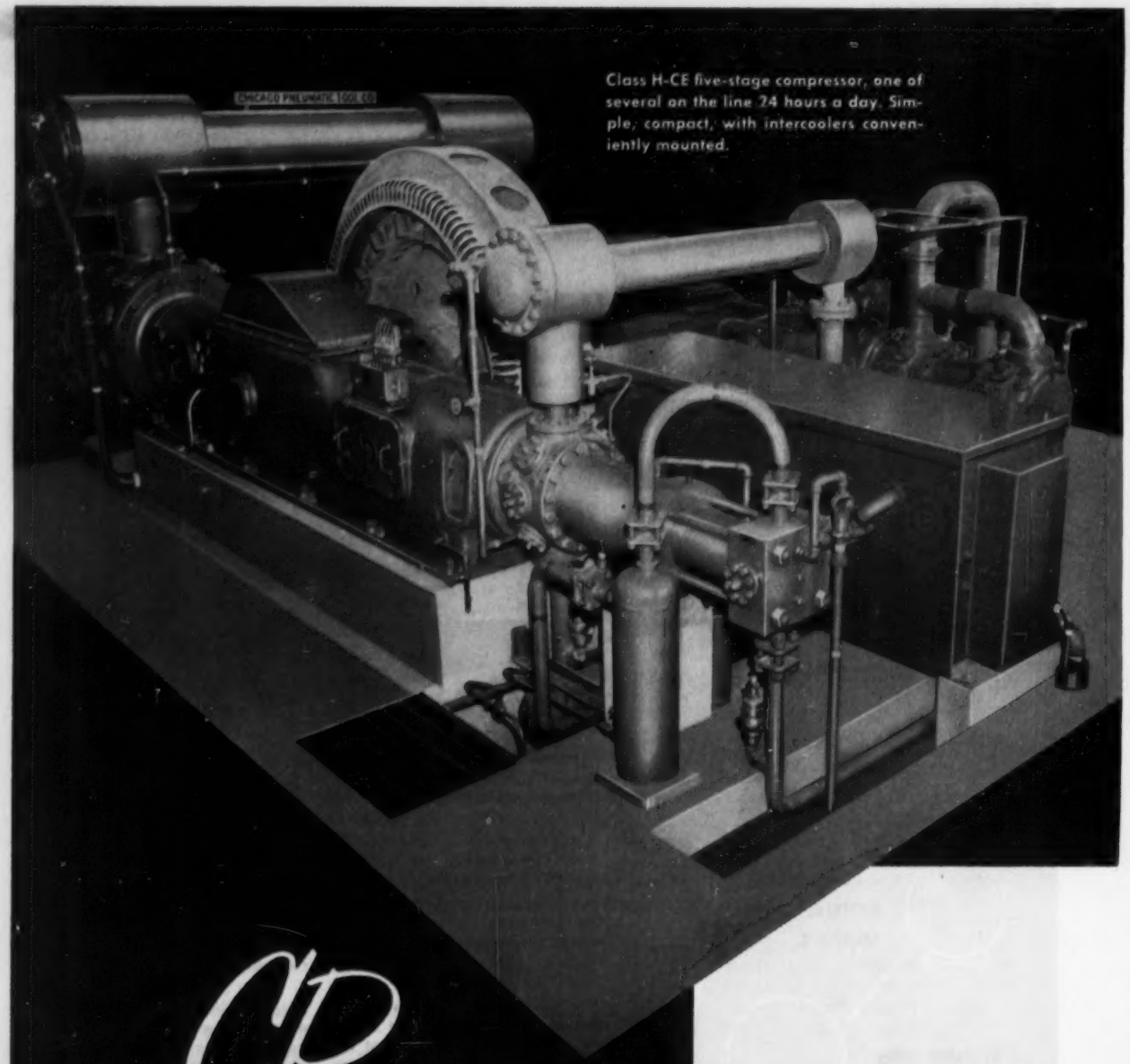

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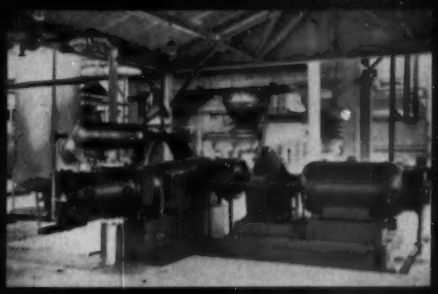
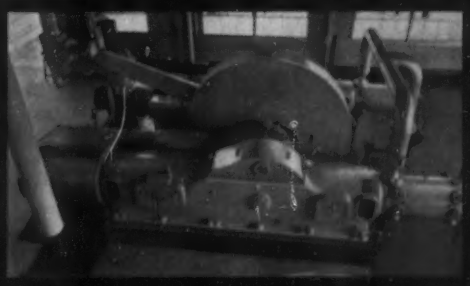
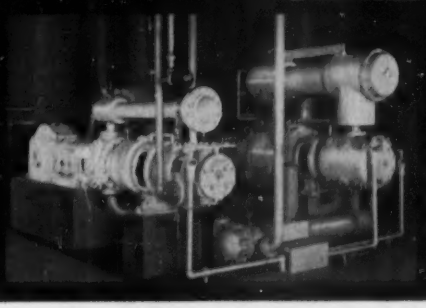


Non-lubricated, hydrogen recycle compressor, with enclosed distance piece, electric motor-driven through gear reducer.



Class "H" steam-driven, single-stage booster compressor handling hydrocarbon gas.



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According to the fabric manufacturer, hundreds of such suits have been undergoing on-the-job evaluation during the past four years. They protect against radiant heat; are light weight, flexible and durable enabling the wearer to work comfortably.

▶ **Many Types**—Twelve manufacturers of industrial clothing now offer nationally a wide range of aluminized clothing. Either asbestos or cotton duck are available as stock fabrics; fibre glass and other special materials can be provided on order.

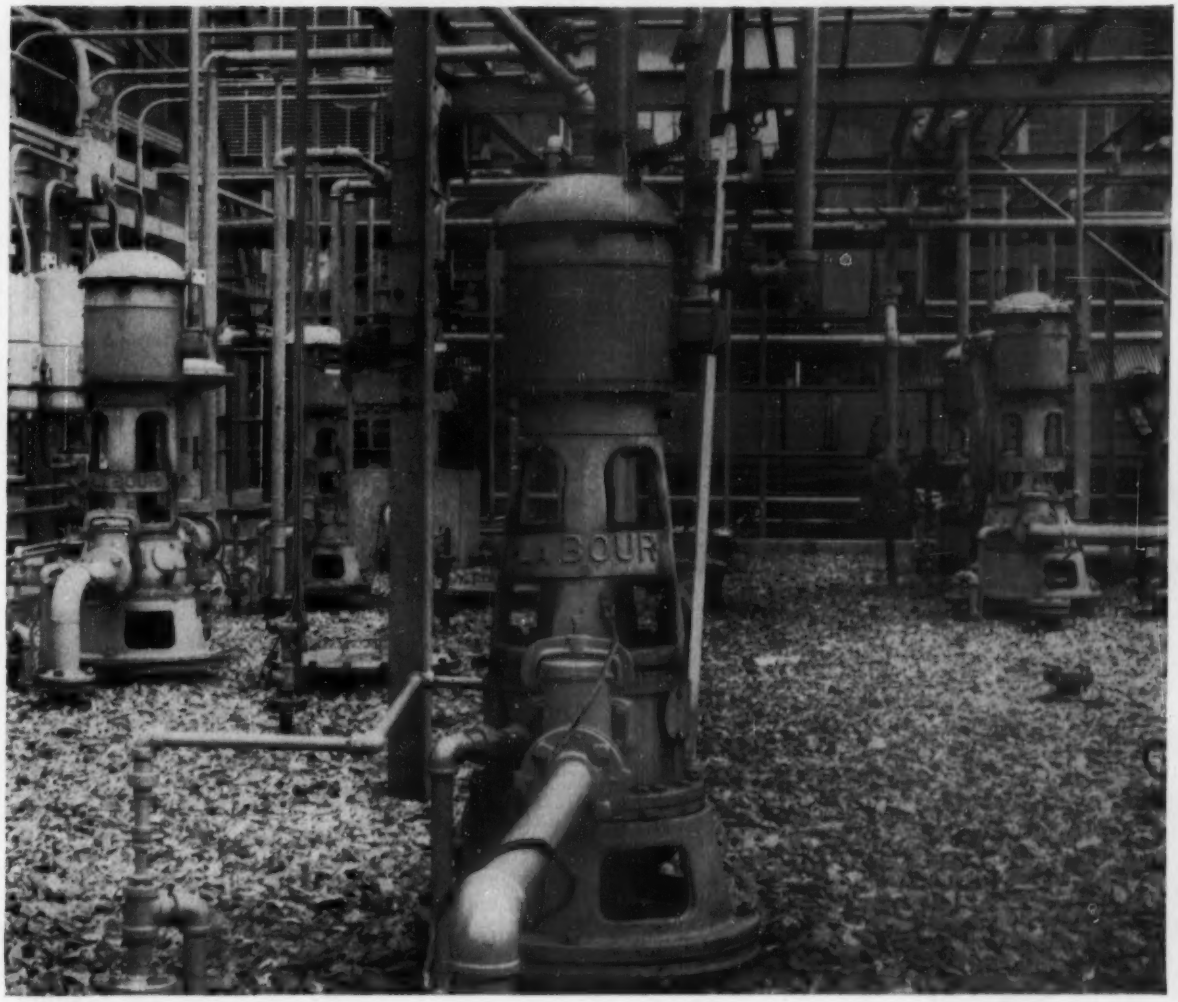
The variety of garments includes: firemen's coats; long coats, aprons, spats and gloves for steel workers; coats, suits, gloves and helmets for stand-by fire-fighting equipment in industrial plants; quilted suits with aluminum-coated fabric exteriors for use in ovens and furnaces; emergency suits and other garments designed for specific "hot jobs" in specific industries.

▶ **Breach the Thermal Barrier**—During the recent demonstration, Engineer D. J. Bennett from Zanesville, Ohio, entered the 1,200-F. oven carrying an armload of wood. He was untouched by the heat although the wood burst into flames while he held it.

In a return trip, Mr. Bennett sat in a wicker armchair while it burned (see cut). Then, possibly feeling hungry, he carried in a steak which cooked to medium rare within 1½ min. exposure time.

Engineer Bennett's heat-impervious suit consisted of aluminum-coated fibre-glass material backed by fibre-glass quilting. This suit has been used about 200 times during repair work in ceramic kilns at temperatures in the 1,200-F. range.

Actually, Mr. Bennett reports that he has worn the suit at temperatures up to 1,400 F. and "never felt the heat." Commenting on the reason, Bennett said, "Nine-tenths of the heat is reflected away by the aluminum coating and the little heat that gets through is dissipated by the layer of glass-fibre quilting beneath the aluminum coating. The only heat I feel is the ac-



Historically Significant

The LaBour pumps in this picture are relatively new, but they are nevertheless significant of important historical facts. The first LaBour pump was installed by Tennessee Eastman Company in this plant at Kingsport, Tenn. in 1931, and they have purchased a total of more than a hundred additional LaBours at intervals since then.

Most of the LaBour pumps being sold today go to customers like this one, who know from their own experience that LaBour means dependable service with minimum maintenance. And because LaBour was the first commercial producer of a self-priming centrifugal pump, the experience records of many companies go back more than 30 years.

The pumps in the above picture are LaBour's latest packingless type, which of course were unknown in 1931. The consistent performance records of the earlier LaBours, however, warranted the choice of the new ones, just as this whole history warrants your investigation of LaBour pumps for your chemical-handling jobs.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

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New Maintenance Tools & Supplies

Protective Suit 262A
Valve Grinder 264A
Fire Nozzle 264B

New Packaging & Handling Equipment

Dark-Area Handling System 266A
Belt Conveyor 266B
Bag Conveyor 266C

New Processing Equipment

Breaker Conveyor 268A
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New Fluids Handling Equipment

Rotary Pumps 272A
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New Instruments & Controls

Industrial Timer 274A
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Chlorine Detector 274C
Level Controller 274D
Shutoff and Alarm 274E

New Electrical & Mechanical Equipment

Oil System 276A
Shaft Seal 276B
Electric Motor 276C
Power Package 276D
Electronic Mount 276E
Clutch 276F

New Heating & Cooling Equipment

Valve Warmer 278A
Resistant Exchangers 278B
Steam Purifier 278C
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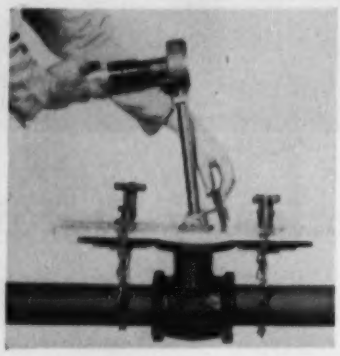
cumulation of my own body heat."

▶**Trial Record**—Reports from four years of evaluation in the field indicate that the aluminized fabric has saved lives, prevented property damage and saved hundreds of thousands of dollars in production time by allowing quicker entry into hot areas.

An eastern steel company reported an incident in which molten slag showered on two men who happened to be wearing long coats of aluminum-coated asbestos. The slag, which normally would have killed the men, rolled off the coats and left the men with only minor burns.

In another instance, a midwest firm saved 35,000 man-hr. in production time because an engineer was able to don an aluminized suit and enter a hot zone immediately to make a 10-min. repair. Otherwise, the repair would have necessitated several days cooling off and several days reheat in addition to the repair time.—**Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.** 262A



Valve Grinder

Regrinds any globe or gate valve in place.

Labor savings as high as 400% are possible when regrinding valve seats with the new motor-driven Dexter valve reseating grinder, it is claimed. With this machine, any globe or gate valve from ¾ to 12 in. can be reground without removing the valve from the line.

Irregular valve seats are refaced from the same "reference point" used by the manufacturer in machining the original seat. That makes the reground valve as tight as new obviating need for replacement valves.

Grinder can refinish the seat of any valve no matter what the hardness. Reason is the use of a new high-speed motor and recently developed cloth grinding elements.—**Leavitt Machine Co., Orange, Mass.** 264A

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Nozzle weighs 54 lb., is 40 in. long, and has a 2½-in. connection for hose or pipe. It may be mounted on mobile units or used with fixed piping near process units.—**National Foam System, Inc., West Chester, Pa.** 264B

How electronics makes P-K exchangers better than ever

This man is expanding tube ends into the tube sheet—the "inner face" of a shell and tube heat exchanger that holds each tube in place. By doing it electronically, with the equipment you see here, the circumference of each tube is joined to the face of the exchanger with exactly the same pressure.

This minimizes the possibility of leaks developing—even when a mile of tubing and hundreds of tube ends are involved, as they are in many of P-K's special exchangers.

But fabricating procedures like these are only part of the story. Every P-K unit is "computed" for its thermal rating and design.

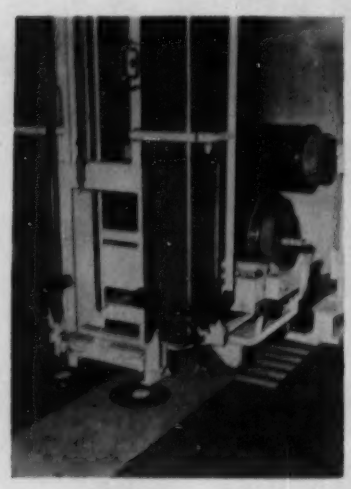
This automatic check of a unit's thermal rating is not only a safeguard, but can often save you money. And it allows P-K to give a full and complete guarantee that each unit will perform at its rated heating or cooling capacity.

An increasing number of processors, engineers, and contractors have come to rely on P-K's painstaking fabrication and testing procedures —and their check, and double-check, of a unit's thermal rating. We would be pleased to design and build exchangers for you.

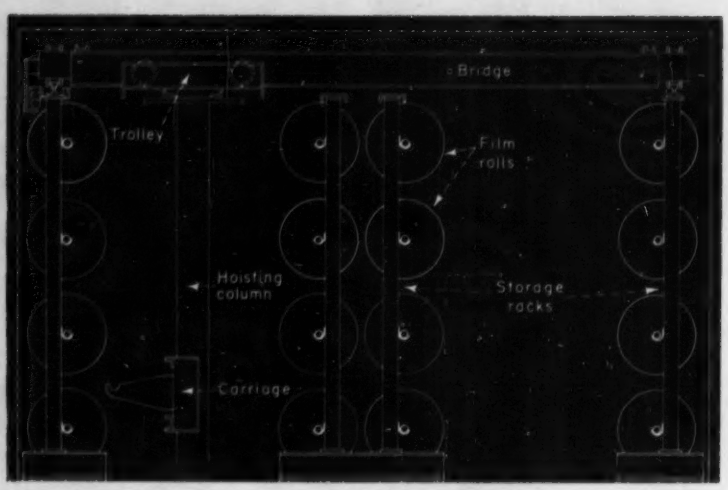
The Patterson-Kelley Co., Inc.,
210 Hanson St., East Stroudsburg, Penna.
Offices in principal cities.

Patterson Kelley
Chemical and Process Division

Twin Shell Blenders • Autoclaves • Pilot Plants • Heat Exchangers • Ribbon and Double Cone Blenders • Lever Lock Doors



BULLSEYES revealed by safe-lights indicate roll pickup spot.



ROLLS stored in complete darkness are moved smoothly in and out of the storage racks by carriage on overhead crane that moves atop the racks.

Darkness No Bar to Handling Film in Storage

Rolls of sensitized film are handled and stored in the dark by an overhead crane system. One man controls movement of the rolls within the storage area.

A material-handling system installed in the film storage room at Ansco's Binghamton, N. Y. plant has eliminated the constant expense of huge, light-proof metal containers. With the system, Ansco has utilized a limited dark-room storage space to the fullest, thereby making possible the elimination of container storage and reduction of cost.

The system stores rolls selectively in tiers on racks. One man operates the equipment, eliminating manual handling and the possibility of accidental contact and resultant damage. Movement, progression and placement are controlled mechanically with absolute accuracy.

▶ **Topsy-Turvy Truck**—Probably the system can be described most vividly by calling it a fork truck suspended upside down beneath a turntable mounted under a travelling overhead crane. The lifting arms or forks move vertically up and down, rotate in a complete circle either clockwise or counterclockwise.

Rails for the crane bridge are mounted atop the storage racks in the 11-ft. high area. This makes the installation completely self-contained since there is no provision in the building for suspending an overhead system from the ceiling.

▶ **What Happens in the Dark**—Rolls of sensitized paper enter the storage area on dollies. When a dolly reaches the unloading position, it is locked in place. This position is indicated by stripes painted on the floor.

The hoisting column with lifting arms lowered then is brought into position to pick up the roll from the dolly. The correct position is indicated when two small safe-lights at the bottom of the column center over two bull's-eyes on the floor.

The operator actuates the column to lift the roll off the dolly. Then the crane can be moved to the desired storage spot, but only if the trolley is in the proper position on the bridge to prevent the roll from hitting another roll or rack.

When the crane has been moved to bring the hoisting column to the desired storage location, as shown again by two bull's-eyes, the operator actuates the carriage which moves automatically to the proper height. Then the trolley is moved forward the proper amount before lowering to deposit the roll in the rack.

When a roll is removed from storage, the same procedure is repeated in reverse.—**Chicago Tramrail Corp., 1330 South Kostner Ave., Chicago 23, Ill.** 266A

Belt conveyor for packages of all types from cans to bags has unusual three-stage cover. Individual segments grip uneven surfaces.—**Goodyear Tire & Rubber Co., Akron 16, Ohio.** 266B

Bag conveyor has adjustable speed and telescoping frame that varies conveying length from 7 to 12 ft. Pulleys are self-cleaning, belt is 5-ply neoprene over duck. **Richardson Scale Co., Van Houten Ave., Clifton, N. J.** 266C

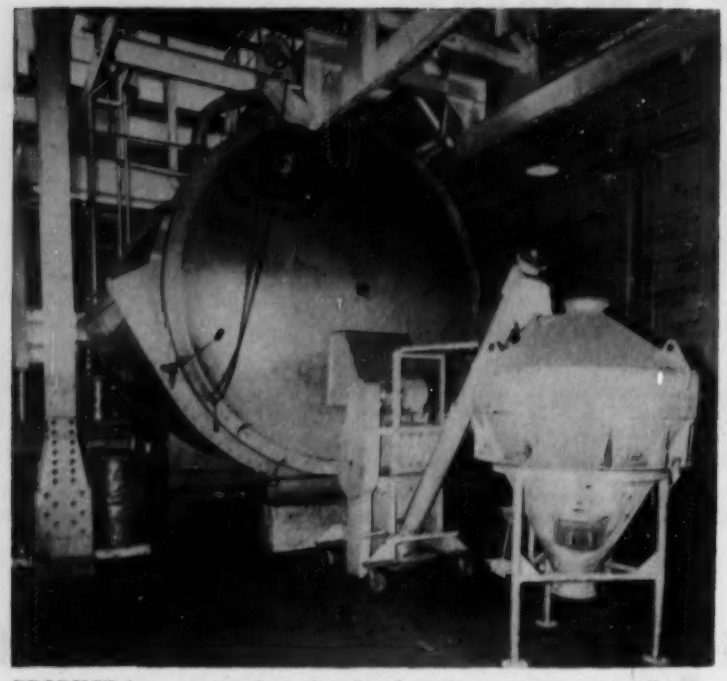
NO LEAKAGE
NO CONTAMINATION
NO STUFFING BOX

Lapp PULSAFEEDER CONTROLLED-VOLUME CHEMICAL PUMP

Lapp Pulsafeeder is a combination piston-diaphragm pump for controlled-volume pumping of fluids. Reciprocating piston action provides positive displacement. But the piston pumps only a hydraulic medium, working against a diaphragm. A floating, balanced partition, the diaphragm isolates chemical being pumped from the working pump parts—eliminates need for stuffing box or running seal. Pumping speed is constant; variable flow results from variation in piston-stroke length—controlled manually by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 678 Wilson St., Le Roy, N.Y.*

Lapp



PRODUCT from reactor drops into breaker, then up conveyor to silo.

Breaker-Conveyor Trims Labor

Combined breaker-conveyor-silo for chemical processing eliminates several time-consuming manual operations, masters hard-to-handle solids.

A new automatic combination breaker-conveyor, installed recently at Toms River-Cincinnati Chemical Corp., Toms River, N. J., eliminates five manual operations during chemical processing.

At this location, the new breaker operates primarily on a dye intermediate, but it is well able to handle other heavy density chemicals. Unit is portable and operates without spewing dust.

▶**Rolls to Process**—When reactor door is opened, the breaker is moved into position with the receiving hopper next to the reactor. A portable silo is positioned beneath the delivery end of the conveyor and connected to it with a flexible connector.

Blocks of product from the reactor are shoveled into the enclosed hopper of the breaker. The material drops into the breaking zone where picks on a rotating drum break the material against an adjustable comb plate.

Drum rotates at 89 rpm. producing 1¼-in. pieces. Comb can be adjusted to produce particles up to 4 in.

Discharge from the breaker is picked up by the screw conveyor and dropped into the portable silo.

▶**Machine Elements**—Body of the breaker is 32 in. long, 20-in. wide and 34-in. high. It is fabricated of stainless-clad steel with welded webs and flanges. All contact parts of the breaker are alloy steel.

The motor, which drives both the breaker drum and the screw conveyor, is housed on top of the machine. Controls are mounted on a small control panel on the side of the machine.

Maintenance of the breaker requires only periodic lubrication and washdown when changing over from one chemical to another. Three gasketed cleanout openings in the conveyor, a gasketed removable back plate and capped drum cleanout on the breaker body aid maintenance.—**Gifford-Wood Co., Hudson, N. Y.** 268A

Falling-Film Evaporator

Built with floating wiper blades in slow rotor.

Entrainment is no problem in a new falling-film evaporator which features a slow-speed rotor with floating wiper blades set at an angle to speed downward flow.

Any liquid entrained by the exhaust vapor is trapped by a separator built integral with the rotor. This advanced design feature permits use of an internal condenser with decreased cost, elimination of outside piping and decreased floor space requirements.

Wipers are made of impervious graphite or other suitable materials and are held in actual contact with the heated walls of the evaporator by centrifugal force. Design of the retainer allows free radial movement of the blades and replacement without disassembly of the entire still.

Evaporator is built in diameters of 12, 24, 36, 48 and 60 in.—**Pfaudler Co., 1018 West Ave., Rochester, N. Y.** 268B

Filter Leaf

Withstands rough handling without leaking at edges.

Featuring a simple mechanical closure, the Rim-Lok filter leaf is designed to assure that the cloth cannot come out of the frame, and the frame cannot become separated from the cloth cover.

In this leak-proof construction, the filter cloth is held in the frame, which is a simple

Problem: Lengthen time between turnarounds...

Raise production...

Solution: Ljungstrom® Air Preheater

With a Ljungstrom stills stay on stream at top capacity months longer, because preheated air mixes more thoroughly with fuel. More complete combustion greatly reduces slag forming material. You generate higher flame temperatures, increase heat-transfer rates.

That's why four of your present processing units can do the work of five. With Ljungstrom Air Preheaters each unit's output can increase as much as 25%. Example: One pipe still in an eastern refinery went from 12,000 barrels to 18/20,000 barrels after application of a Ljungstrom.

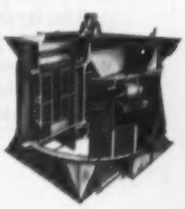
How fast is "WRITE OFF"?

Ljungstrom has many other advantages. You save up to 20% in fuel... furnace design is more economical, with no need for convection surfaces... many fuels you used to throw away can be used... through-put is consistently improved... product quality is higher. You can see, therefore, why a Ljungstrom is paid out in nine months or less.

For more complete details on what the Ljungstrom Air Preheater can do for you – for an analysis of the heat recovery benefits attainable in fuel burning equipment – call or write The Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

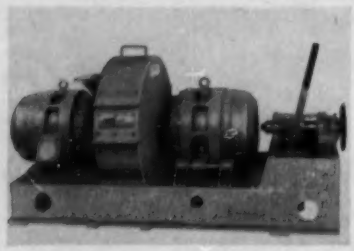
The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

mechanical closure, without the aid of rivets, bolts or solder. Frame bends of 180 deg. engage 180-deg. bends in the cloth to produce a leak-proof seal and hold the cloth taut at all points.

The leaf chamber is designed to improve support for the filter cloth covering and assure low pressure drop for uniform precoating.—**The Multi-Metal Wire Cloth Co., Inc., 1850 Garrison Ave., New York 59, N. Y.** 268C



Attrition Mill

Suitable for many materials at low process cost.

Designed to handle a wide range of materials ranging from fibrous to brittle nature, a new attrition mill can grind, shred, fluff and granulate.

Mill is said to be the first of its kind to permit the use of standard motors in either open or totally enclosed construction from 20 to 60 hp. Also, there are many safety features including steel construction and special-alloy iron spring-cushioned plates, quick-release protection of plates and external adjustment of grinding plates for precise results.—**The Strong-Scott Mfg. Co., 451 Taft St., North East, Minneapolis 13, Minn.** 270A

Agitators

Provide maximum agitation with minimum power.

Improved types of propellor and rake agitators have been designed and patented in Australia for the mining, chemical and food processing industries.

The hydraulic lift-rake agitator has a high-efficiency, vertical worm-drive gear box whose output shaft is direct coupled to the agitator shaft. Gear box, shaft and rakes are supported by four flexible mountings.

A unique parallelogram arrangement actuated by a hand-operated hydraulic ram lifts the rakes higher than has been conveniently possible before. With this arrangement, the shaft and drive components suffer no relative movement to each other.

The propeller agitator also is supported by four flexible anti-vibration mountings to reduce side loads on the bearings.—**Warman Equipment (W. A.) Pty. Ltd., Kalgoorlie, Western Australia** 270B

Cyclone Test Set

Provides flexibility needed to evaluate separations.

This laboratory hydrocyclone test set is being used increasingly by those interested in cyclone evaluation tests.

With the set, you can attain a maximum capacity of about 4 gpm. at a feed pressure of 40 psi. Separation cuts as fine as 5 to 10 microns can be made.

Set contains 15- and 30-mm. diameter hydrocyclones constructed of Pyrex-brand glass. Each cyclone has a complete set of interchangeable vortex finders and apex nozzles. The parts fit together by means of precision-ground glass joints.—**Liquid-Solid Separations, Ltd., 2 Anderson St., S. W. 3, London, England.** 270C

Acid System

Safe, simple handling of acid during dilution.

Plants using acid in carboys and drums will find a safe, simple handling method in new vacuum acid-handling system.

System transfers, measures and dilutes the acid without need for lifting carboys or drums and without subjecting any vessels to positive pressure. The equipment can be furnished as part of the regenerant system of water-treatment processes.

Only a water line need be added to the system, as furnished. Vacuum, created by the water-operated ejector, draws acid from the carboy into the measuring tank. Flow is stopped merely by opening a vacuum breaker, permitting acid in the line to return to the source.

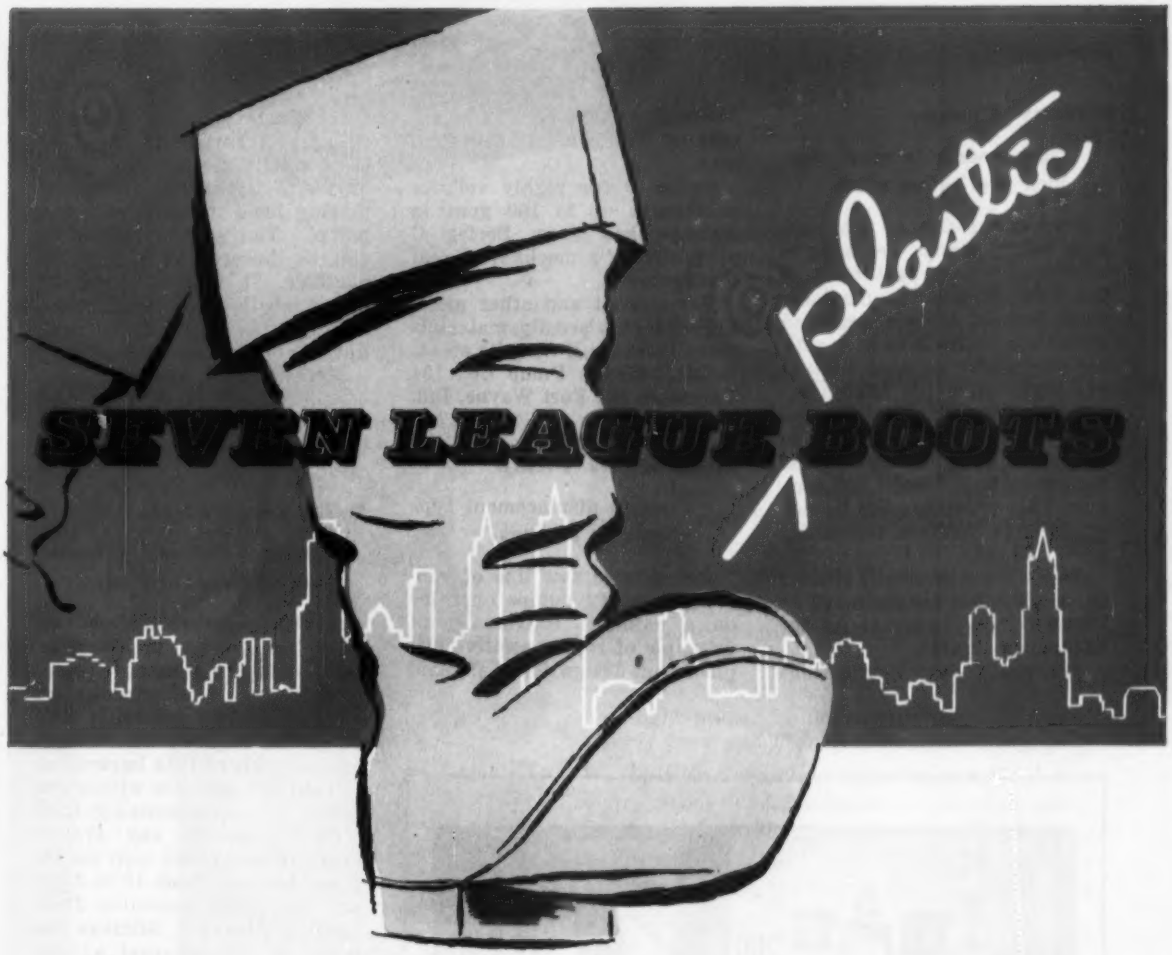
Measured acid is drained into the dilution tank filled with water to give finished regeneration acid.—**Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y.** 270D

Ultrasonic Transducer

Designed for large scale chemical processing.

Announced as the first high-power magnetostriction type transducer, this unit was designed specifically for processing such as emulsification, dyeing, impregnation, degassing, particle size reduction, dispersing and decontamination.

Transducer can be used with liquids at temperatures far above boil point, thus overcoming limitations inherent to barium titanate transducers. Units can be grouped externally on existing process equipment and driven in tandem by electronic or rotary driven above-audible frequency generators ranging from 2 to 150 kw.—**Acoustica Associates, Inc., Glenwood Landing, L. I. N. Y.** 270E



In giant strides the plastics industry moves forward . . . developing and producing a vast array of products to meet ever-increasing industrial and consumer requirements.

Escambia Chemical Corporation took its first step in true "seven-league" style . . . moving in a matter of months from paper plan, through plant construction, to production of its first family of products—ammonia, nitric acid, ammonium nitrate and nitrogen fertilizer materials.

Construction is rapidly nearing completion on Escambia's 30 million pound Polyvinyl Chloride Resins plant at its site near Pensacola, Florida.

Production will start shortly on the second family of products beginning with a general purpose, easy processing Polyvinyl Chloride Resin for use in the calendering, extrusion and molding industries. Following this, the plant will produce a molecular weight range of straight PVC Resins including types for electrical and rigid applications.

As a dependable new source of raw materials, Escambia joins the forward march of a fast moving, dynamic industry.

ESCAMBIA CHEMICAL
CORPORATION

261 MADISON AVENUE • NEW YORK 16, N. Y.

Rotary Pumps

New models to meet complex application needs.

Five new series of internal-gear rotary pumps are said to offer unparalleled versatility in the field of positive displacement pumps. All are designed with circular teeth to give rolling contact for reduced friction and high volumetric efficiency.

Series A standard duty pumps cover 10 basic sizes from 3 to over 100 gpm. in two speed ranges up to 650 and 1,800 rpm. max. This group handles liquids of light to medium viscosities up to 125 psi.

Series B are generally similar to Series A but are approved by Underwriters' Laboratories for hazardous liquids.

For heavy duty applications Series C pumps handle in excess of 300 gpm. at 650 rpm. max.

Series D for highly volatile substances up to 100 gpm. is distinguished from Series C primarily by a mechanical seal arrangement.

For asphalt and other medium or high viscosity materials there is Series E with its steam jacket.—**Wayne Pump Co., 104 Tecumseh St., Fort Wayne, Ind.** 272A

Submerged Pump

Positive displacement type offered as package.

An entirely new line of submerged rotary pumps operates on a patented universal-joint principle of rotary positive displacement design. They are said to eliminate priming problems.

Pump is furnished complete in a ready-to-install package unit with discharge column and driving head integral with the pump. The suction assembly can be lowered into a 15-in. manhole. It can be used in either shallow or deep tanks merely by selecting the correct number of 5-ft. sections.

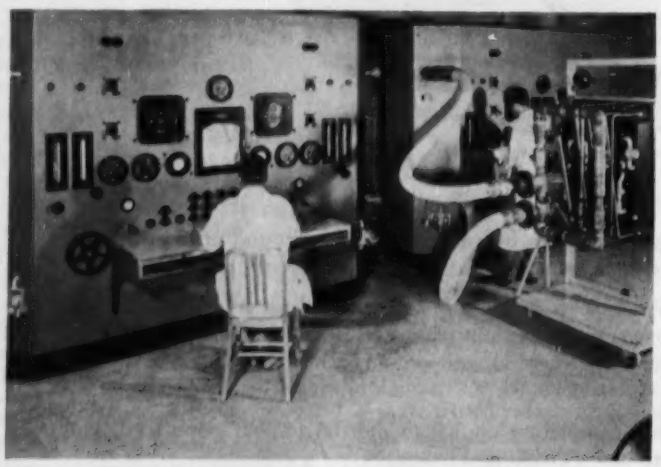
Models are available for capacities up to 300 gpm.—**Granberg Corp., 1308 67th St., Oakland 8, Calif.** 272B

Pressure Switch

Holds system pressure within limits desired.

A new pressure switch can sense two different pressures in one system and actuate independent electrical circuits at any two desired points. It may be used to maintain system pressure where it is imperative to hold the pressure within the range of predetermined values.

Switch senses any system pressure accurately over an adjustable range from 15 to 3,000 psi. for proof pressures from 3,000 to 7,000 psi. Settings are made by two external adjustment screws which can be locked in place to avoid accidental disturbance.—**Barksdale Valves, Pressure Switch Div., 5125 Alcoa Ave., Los Angeles 58, Calif.** 272D



Meter Manufacturer Opens New Test Facility

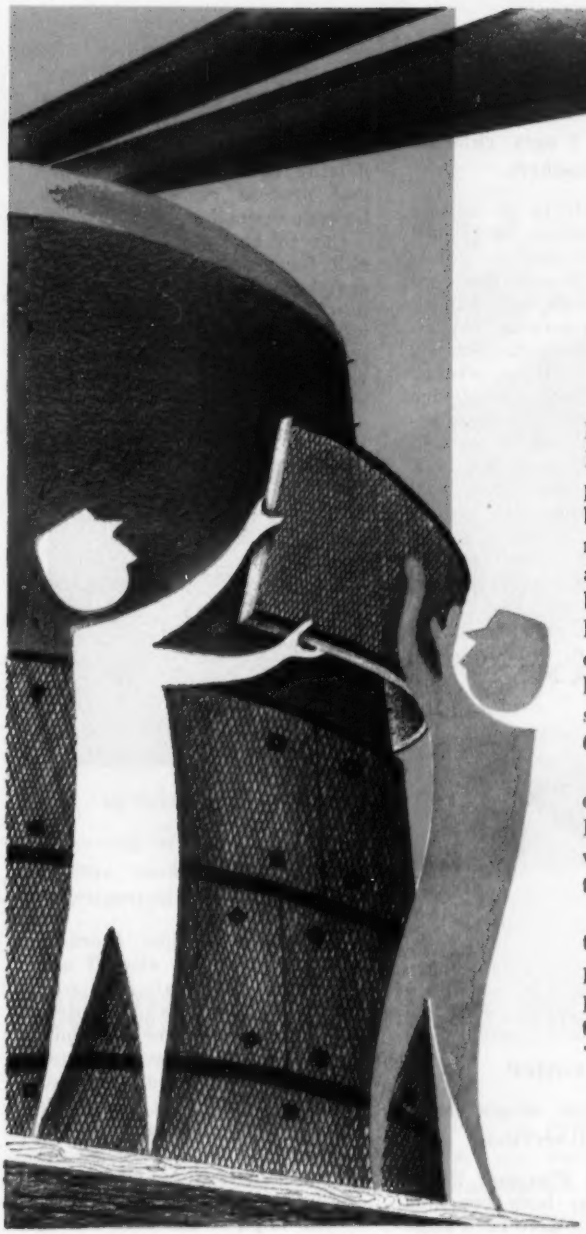
You are looking at master calibration stands in the new Allan P. Colburn Memorial Flow Laboratory, one of the most completely equipped hydraulic test facilities in the U. S. A. This laboratory is designed specifically to calibrate flowmeters on both a production and a research basis. The calibration units operate on the standpipe-weigh-stand principle.

Also available are volumetric displacement type calibration stands as well as facilities for testing density and viscosity measuring instruments. Accuracy of the calibration stands is within ±0.1% of absolute flow rate over a present capacity range from 100 to 125,000 lb. per hr. of liquid hydrocarbon.—Fischer & Porter Co., Hatboro, Pa. 272C

Equipment Cost Indexes

Industry	Mar. 1956	June 1956
Avg. of all	201.3	204.2
Process Industries		
Cement mfg.	192.5	194.8
Chemical	201.9	204.3
Clay products	187.0	189.2
Glass mfg.	190.7	193.0
Paint mfg.	194.3	196.6
Paper mfg.	194.6	196.9
Petroleum ind.	198.3	200.7
Rubber ind.	200.8	203.2
Process ind. avg.	198.4	201.4
Related Industries		
Elec. power equip.	203.8	206.2
Mining, milling	203.2	205.6
Refrigerating	224.9	229.0
Steam power	190.2	192.5

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1956, pp. 194-5 for annual averages since 1913.



Flexible blanket speeds insulation of large, heated equipment

Flexible, easily handled Armstrong Armatemp* Blanket Insulation is especially fast and easy to apply to the curved and irregular surfaces of tanks, breechings, heat exchangers, and other large equipment operating up to 1200° F. Armatemp Blankets are made of felted layers of mineral wool, faced on both sides with various combinations of wire mesh, lath, and fly screen. The insulation's smooth, firm edges can be butted tightly together for efficient, heat-tight joints. Armatemp comes in standard sizes of 2′ x 4′ and 2′ x 8′ and in thicknesses of 1″ to 6″. Special sizes are also available on order.

Armatemp Blanket Insulation is one of the many quality products in the complete line of Armstrong Industrial Insulations. Armstrong also offers a well organized contracting service, geared to install these materials efficiently and economically.

For additional information on Armstrong Armatemp Blanket Insulation or any other Armstrong product that may help to solve your insulation problems, send today for free booklets. Check the ones you want on the coupon below.

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INDUSTRIAL INSULATIONS

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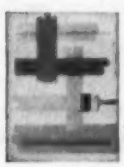
☐ Armstrong Armaglas† Insulations for Piping, Tanks, and Vessels

☐ Armstrong LT Cork Covering for All Cold Lines



☐ Armstrong Insulcolor®, Weatherproof Coating in Eight Colors

†® Armstrong Cork Co., Manufactured by Owens-Corning Fiberglas Corp.

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Position .....

Company .....

Address .....

City ..... Zone .... State .....

Industrial Timer

Continues to run after power outage.

A new electrical instrument timing component keeps running when power fails or circuits short out.

The duplex time component (U. S. Pat. 2,563,888) is an accurate, synchronous electric time unit combined with a spring-driven time unit which is held in reserve. If electricity should fail, the spring-driven unit goes into action instantly. Upon power resumption or circuit repairs, the synchronous electric motor again takes over.

Timer has been piloted in chart drives and dials, time switches, and day-night thermostats. Its use has been predicted in such applications as temperature, pressure and vacuum recording devices; indicating and controlling instruments; heat treating and oven control.—**Industrial Timer Instruments Co., 189 West Madison St., Chicago 2, Ill. 274A**

Cylinder Sampler

Automatically checks purity of five compressed gas cylinders.

Large quantity sampling is quick and easy with a new automatic compressed gas cylinder sampling station designed to check purity of five cylinders at a time.

When operated with an argon purity instrument, with a range of 99.9-100%, it will sample each cylinder to an accuracy of 5 ppm. impurities. If all cylinders are acceptable, eight minutes is required to analyze five cylinders. The length of time can be varied and will need to be altered for other types of analyzers.

The checking system is about 9 ft. long and 5 ft. 3 in. high. The operator loads the rack with five cylinders, just like loading a filling rack, presses the start button, and the automatic sampling station completes the analysis.—**Thermco Laboratories, Michigan City, Ind. 274B**

Chlorine Detector

Warns of 3 ppm. chlorine in the atmosphere.

Now available is an instrument that detects as little as 3 ppm. of chlorine gas in the atmosphere. Wherever gas concentration exceeds this amount, the detector operates electrically to warn of the danger. By giving alarm at this low level of gas concentration, the device assures counteraction long before the 15 ppm. level is reached where throats become irritated.

Unit is made for either wall or panel mounting. It can be used wherever chlorine gas is used or stored. Operation depends upon the reaction between chlorine gas and chemically treated dry paper.—**Wallace & Tiernan, Inc., 25 Main St., Belleville 9, N. J. 274C**

Level Controller

Trouble-free displacement type for all services.

In the New Flexotrol liquid level controller both bearings and knife edges have been eliminated. Result is extremely trouble-free operation on all services.

The new design introduces a torque table to replace pivoting members. The face of the torque table is free to twist under the action of the displacer thereby driving the torque tube. Normal process residues do not hamper operation.

Control action is interchangeable for proportional or differential gap response. The proportional band is 1 to 150% with automatic reset as an extra feature.—**Kieley & Mueller, Inc., Middletown, N. Y. 274D**

Shutoff and Alarm

For automatic processes, operates without sensing elements or electronics.

For the first time, there is available a safety shutoff and alarm for automatically controlled processes which requires no sensing element or electronic circuitry. The device shuts down the process and sounds an alarm when controller fails in the "on" period and sounds an alarm when there is an abnormal "off" period or fusing of the power contactor.

The impulse monitor can be applied to any process involving heat, pressure or flow where the control system uses an on-off, two-position or pulsing type of control mode and where the input has reasonable duration.

Operation of the monitor is a direct function of the signal from the automatic controller. The absence of sensing elements such as thermocouples and thermal bulbs, and of electronic circuitry assures positive dependable operation with no possibility of failure from added components. — **Damol Corp., 541 Land Title Bldg., Philadelphia 10, Pa. 274E**

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Keeping the business end of a hull in business!

Every craft, from a roaring speedboat to the lazy family canoe, is only as seaworthy as the thin "skin" of finish that shields it. And this vital "skin" has to be tough to provide active protection from water, wind, weather!

Superior resins produced through the use of Olefins are greatly responsible for modern rugged finishes. Olefins are members of Atlantic's petrochemical family; that's why you see the oil refinery in the picture.

Olefins are used in production of quality resins for heavy-duty varnishes. They offer faster drying, increased durability against wear and erosion. Typical applications of resins include industrial flooring, bowling alleys, boats. Olefins are also being used profitably in the manufacture of rubber chemicals, germicides, insecticides, dyes and surface active agents.

Your own business may have use for these or any one of a wide variety of Atlantic petrochemicals. Our sales engineers will gladly work with you in putting any of these chemicals to work in order to improve your present product, develop new products or to speed production—with cost-cutting savings as the result.

For full information, write or wire The Atlantic Refining Company, Dept. N-11, at the nearest office listed.

Philadelphia, Providence, Charlotte, Chicago

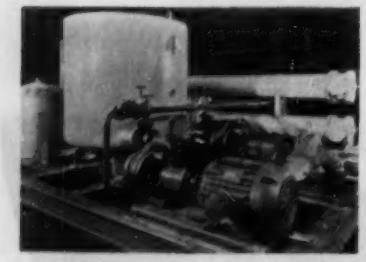
In the West:
L. H. Butcher Co.

In Canada:
Naugatuck Chemicals Division of Dominion Rubber Company, Ltd.

In Europe:
Atlantic Chemicals SAB Antwerp, Belgium

In South America:
Atlantic Refining Company of Brazil, Rio de Janeiro

ATLANTIC
PETROLEUM
CHEMICALS



Oil System

Used with compressor and steam turbine installations.

A packaged lubricating-oil system has been developed for use with compressors and steam turbine drivers.

All components are mounted on a common base. Accessibility to gages and maintenance points has been increased by a compact arrangement for oil reservoir, pumps, motor, turbine, coolers and filters. In addition, the arrangement minimizes the number of components needed and cuts down on space requirements.

The system shown is one of two used in a butadiene process in the southwest. Each serves two axial and two centrifugal compressors. — **Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.** 276A

Shaft Seal

For light oil, resists aging and oxidation.

The new DuFelt oil and bearing seal is used to seal light oils when no head of oil exists. It has excellent resistance to aging and oxidation and is less permeable to gases and other substances than many seals.

DuFelt is a special lamination of Hycar and felt. It is compressible for tight fit, grease absorbent for low friction, hard and tough for long life.

Normal bearing temperatures do not affect the Hycar lamination adversely. It is satisfactory under acid conditions down to 2.5 pH and will withstand mild alkaline solution at normal temperatures.—**The Felters Co., Felt Products Div., 210 South St., Boston 11, Mass.** 276B

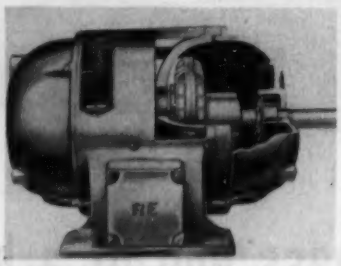
Electric Motor

Has rotor supported by film of gas or liquid.

A low-cost electric motor has been unveiled which will never require bearings or lubrication.

The rotating assembly is supported within the stator on a film of fluid which may be gas or liquid. The load-supporting fluid acts in the gap region. Motor alignment problems, end-bell housings, bolts, wicks, conventional bearings and grease disappear completely.

Other gains: lower cost since motors can be made smaller and lighter; exceptionally quiet operation; greater operating efficiency due to more precise and uniform air-gap control; no bearing or lubrication maintenance.—**Air-Glide Engineering Laboratories, Vermilion, Ohio.** 276C



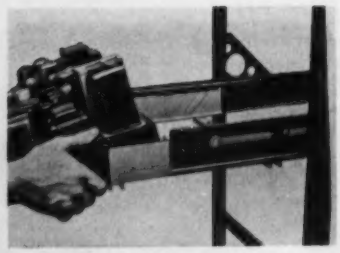
Power Package

Coupling and motor within single frame.

Included as part of the new Flexi-Shaft motor is a fluid coupling that uses steel shot instead of true fluid. Adapted from the new Dodge Flexidyne drive, this coupling is mounted inside the motor's frame to provide a single-frame package.

This new unit can be supplied with many combinations of magnetic brakes and gear reducers to solve unique drive problems. Primary features are smooth load acceleration, protection against jamming of equipment and the ability to start heavy loads on lower actual operating horsepower.

Flexi-Shaft motors are built in ratings from ½ through 15 hp.—**Reuland Electric Co., Alhambra, Calif.** 276D



Electronic Mount

Eases mounting of equipment in cabinets or racks.

With the new Easy-Mount chassis slide assembly, Model CTFM, you overcome the most troublesome phase of mounting —bolting the slide to the rear of the cabinet. It can be used on control panels or other electronic equipment.

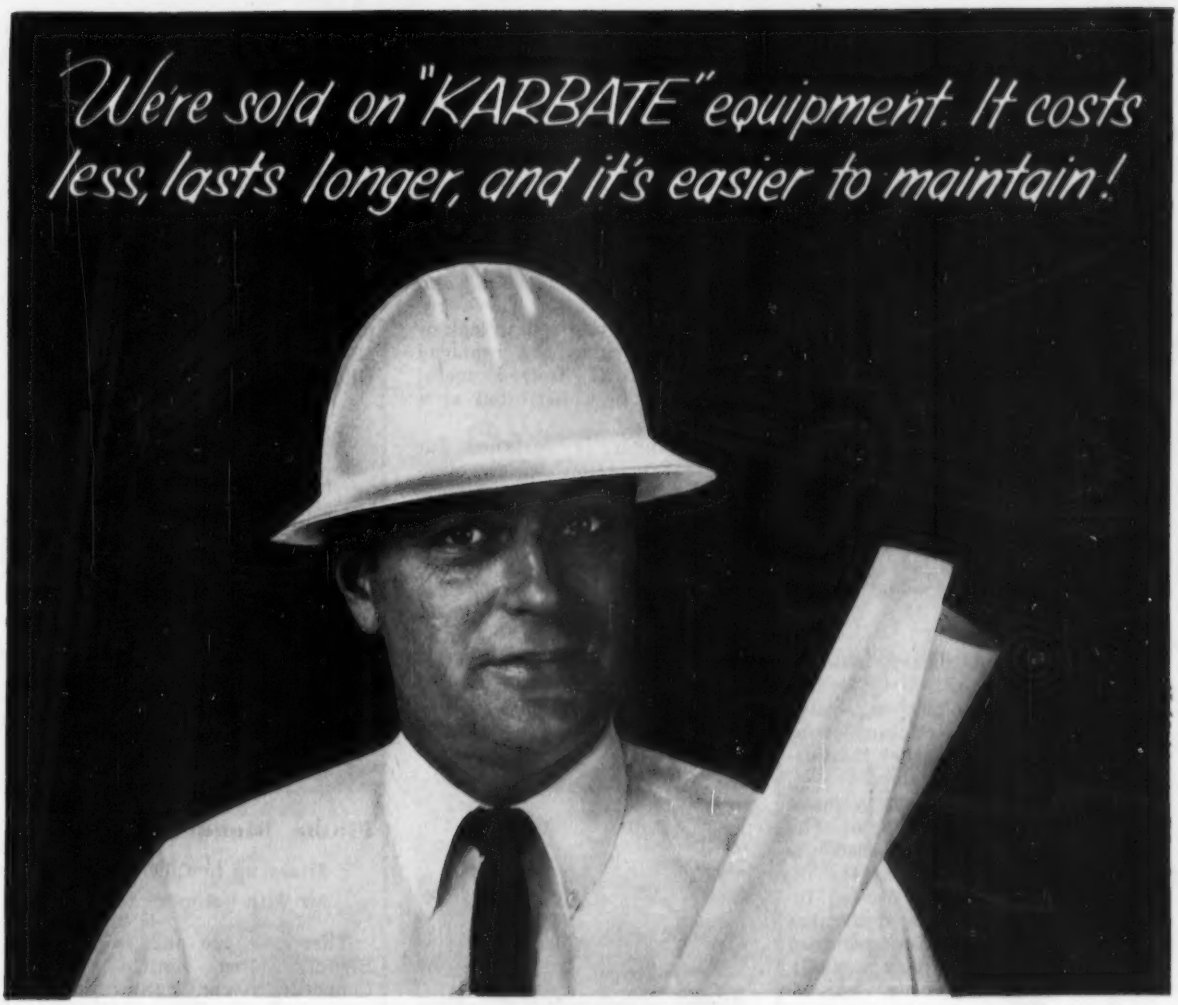
Assembly has a built-in crossbar which provides support at the rear and also serves to prealign the slides for perfect fit without adjustments. After the slide assembly has been attached to the front rails of the cabinet, the chassis is simply set into the cradle. The complete installation takes about 5 min. and requires only a screwdriver.—**Chassis-Trak Corp., 525 South Webster St., Indianapolis, Ind.** 276E

Clutch

Offers advantages over centrifugal type clutch.

A unique clutch with exclusive "lock-in" toggle action disengages at a speed 400-500 rpm. slower than it engages. Resultant gains over the centrifugal clutch: the engine can idle at a satisfactory speed without slippage at relatively low operating speeds; and there is greater load capacity in proportion to clutch weight.

The Tog-O-Loc clutch is available for use on a wide variety of gasoline and diesel engines in the 10-50 hp. range. The extra large friction area and simplified construction provide long trouble-free performance, according to the manufacturer. — **Salsbury Corp., 1161 East Florence Ave., Los Angeles 1, Calif.** 276F



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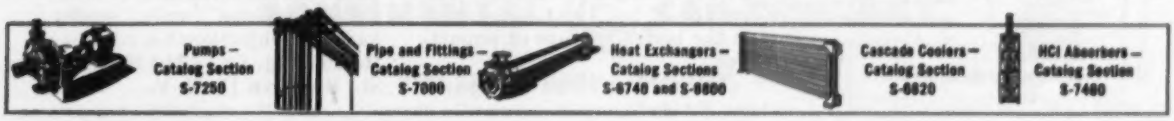
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Valve Warmer

Of embossed metal shaped to fit valve.

Designed for easy installation and removal, the Thermo-Panel coil clamp-on valve warmer can replace clumsy tube coils or be used rather than expensive jacketed valves.

The valve warmer is made from two sheets of metal. The outside sheet is embossed to provide flow channels; the inside sheet is flat. Welded together and then curved to fit the valve, the unit assures good heat transfer for wax, asphalt, petroleum, glycerine, etc. — **Dean Thermo-Panel Coil Div., Dean Products, Inc., 616 Franklin Ave., Brooklyn 38, N. Y.** 278A

Resistant Exchangers

Feature flexibly mounted impervious-graphite tubes.

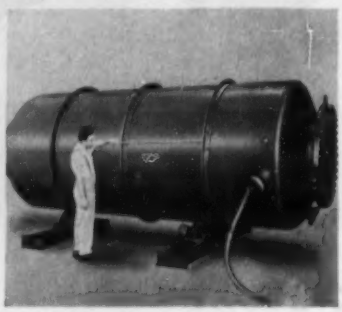
A custom-designed line of acid-resistant heat exchangers offers special design features aimed at long service life.

Impervious-graphite tubes are mounted in the tubesheet by means of neoprene ring gaskets (U. S. pat. 2,281,594). As the gaskets are driven into place during installation, they compress to form a tight, flexible seal.

With this type of construction the tubes are protected fully against expansion and contraction strains. There are no floating tubesheets to leak or stick. The tubes are replaced easily, and if desired, metal tubes can be substituted at a later date.

Exchanger is designed for vertical erection which eliminates need for intermediate tube supports. A wide choice of tubesheet materials is available.

Tubeside pressure ranges from full vacuum to 50 psig. at temperatures up to 180 F. Design shellside steam pressure is 15 psig.—**Swenson Evaporator Co., Harvey, Ill.** 278B



Steam Purifier

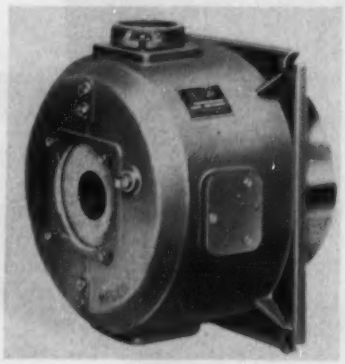
Cleans exhaust steam for return to boiler.

You can cut the cost of power operation by conserving water and steam through use of the new model LS Hi-eF purifier. Installed in low-pressure steam lines on the exhaust side, it removes oil, pipe scale and other impurities so that the steam can be returned to the boiler.

This procedure reduces the amount of raw water required for the boiler. And condensed steam is less costly to generate into steam than raw water. Furthermore, condensate from purified steam lessens the danger of hot spots developing in the boiler because of impurities.

In the first stage of separation, large droplets are removed from the steam by impinging against a baffle. A uniquely designed second-stage separator removes the fine mist by centrifugal action to complete the cleaning action.

Unit shown is a 45-in. size installed horizontally in a 42-in. pipeline.—**V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.** 278C



Flame Blender

Mixes up to 1,000% excess air with hot gases.

Through use of a new Blended-Flame unit, high-temperature combustion products can be blended thoroughly with up to 1,000% excess air. This insures complete combustion of fuel and gives better circulation of heat in furnaces, ovens, kilns and other heat processing equipment at temperatures ranging from 400 to 1,800 F.

Unit assures a stable flame and prevents the incoming excess air from interfering with the ignition and combustion of the fuel within the refractory tile. Excess air flows around the outside of the tile, so that blending occurs only at the tile outlet and periphery of the burner flame.

The path of the excess air is as straight as possible in the blending stage. Thus, combustion goes to completion before complete blending takes place. This reduces formation of aldehydes, noxious fumes, smoky haze and objectionable odors.—**Hauck Mfg. Co., 124-136 Tenth St., Brooklyn 15, N. Y.** 278D

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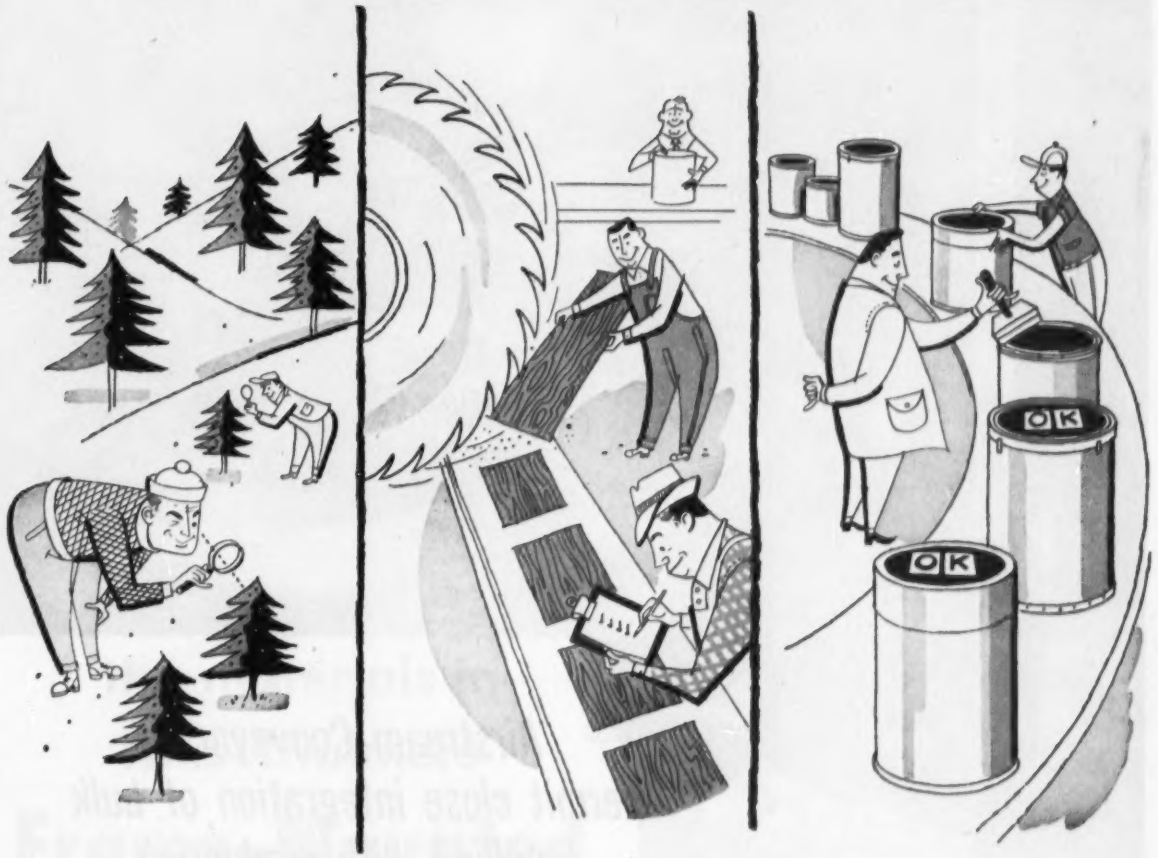

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Companies planning integration of dry bulk materials handling with production should consider the many advantages offered by Dracco Airstream Conveyors.

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Dracco Bulletin 529, "Airstream Conveyors", contains detailed information on equipment and uses. Shows examples. For your copy, write Dracco today.

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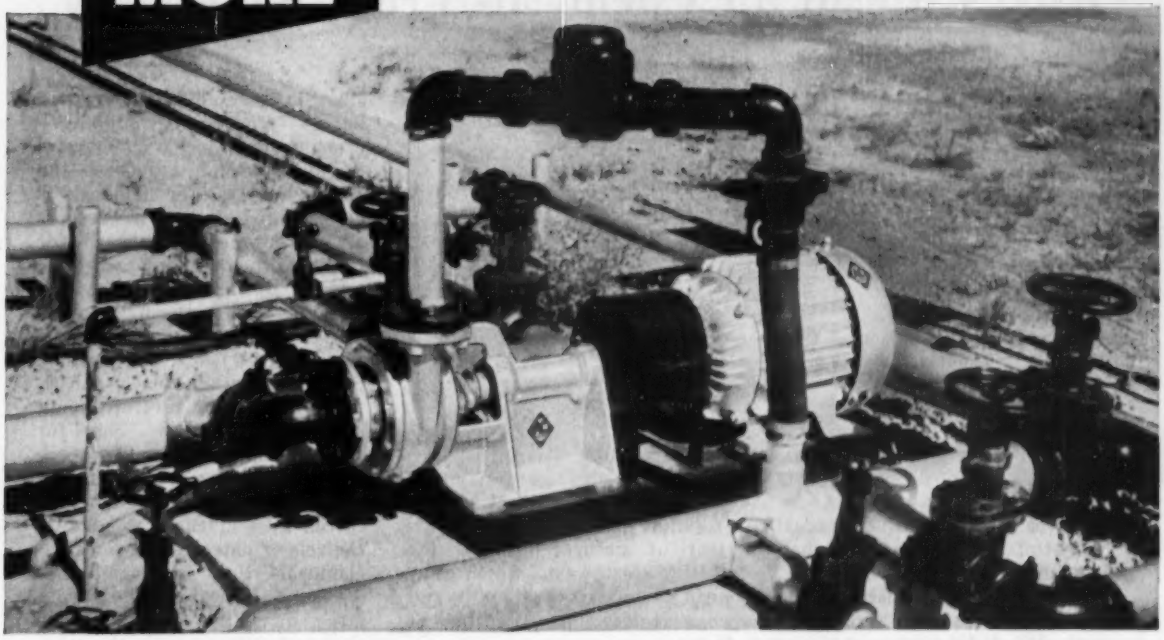
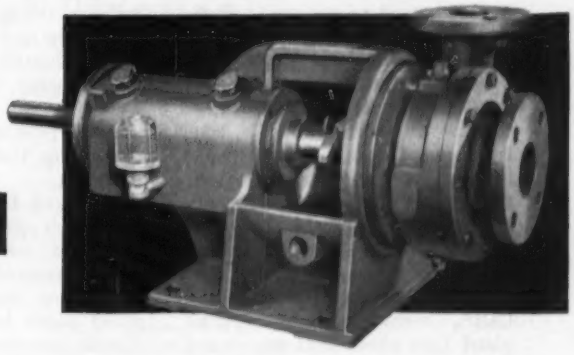


Salt water disposal is the job of this Allis-Chalmers pump in a southwestern oil field. It is driven by an Allis-Chalmers 10-hp motor.

You specify the materials in Allis-Chalmers

Frame-Mounted Pumps



Frame-mounted pumps, either grease or oil lubricated, are available with heads to 400 ft, capacities to 3500 gpm, temperatures to 550 F.

Here's a pump that's built exactly right to handle *your* problems of temperature, corrosion and contamination. Reason: *You* specify the materials that go into *your* Allis-Chalmers pump.

Parts are available in almost every material used in pump construction — iron, bronze, stainless steel, high nickel alloys and others. In addition, you pick the sealing arrangement and specify direct coupling or V-belt drive.

Lower cost per gallon pumped results from the custom design of Allis-Chalmers pumps—and they're priced well below "special" chemical and refinery pumps. Next time you need pumping equipment, talk with an A-C pump specialist. Contact your nearest A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.

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ALLIS-CHALMERS

EDITED BY D. R. CANNON

What's Ahead for Chemicals From Wood?

PRIZE—Rich though remote

- **A new aromatic chemical industry for the taking**

BARRIERS—Still formidable for forest industry

- **Preoccupation with a "physical" product**
- **Inexperience in aggressive market development**

ACTIVATING PRESSURES—Building up fast

- **Pollution control is imperative and expensive**
- **Production costs are squeezing profits**

Frances Arne, Assistant Editor

Wood's chemical potential is admittedly enormous. Yet incentives to tap this silvichemical potential have been less than compelling. As a matter of fact, the inertia of an old industry has stymied all but the scratchiest sort of use of forest products as chemical raw materials.

Today's incentives are stronger but usually go unnoticed. But today's stepped-up economic pressures are forcing a spurt in silvichemicals.

Witness the milestone passed last summer when, for the first time on a commercial scale, conventional forest products were byproducts of chemical operations, not vice-versa. (We exclude such long-established silvichemicals as charcoal, rubber and naval stores.)

Pacific Lumber Co.'s Scotia, Calif., redwood bark extract plant (see photo next page) and Rayonier's Vancouver, B. C., hemlock bark extract plant, both on stream last summer, extract chemical values from virgin bark and only then turn the fibrous residue over for processing into board, insulation and other conventional forest products. (*Chem. Eng.*, Aug. 1956, p. 110).

▶ **The Squeeze is On**—Economic motivations urging more complete chemical utilization are rising in number and intensity. They include: High cost of control of air and stream pollution; higher costs of timber processing and pulping; slow-but-sure increase in costs of chemicals from other natural sources (fossil fuels and ores); and arrival of natural gas in the Pacific Northwest, which may mean increased availability of wood residues now serving as fuel.

All these factors are helping shift the forest products industry from a predominently chemical-consuming to a chemical-producing and consuming status. And although largely negative in character, such factors may well generate enough action to uncover products and processing techniques that forecast volume markets.

▶ **Feast of Leftovers**—Without these rich ports of call the ocean of cheap, available and perennially replaced supply of lignin and other organic products in wood waste has been unable to tempt industry to utilize more than a fraction of 1% of it for chemical purposes.

More than 100 million tons of waste wood are accumulated every year in lumber, veneer and plywood operations. Probably an equal quantity of cheap wood is available as cull trees, uneconomic species and defective bolts left to rot in the woods. Wood residues from mills represent material already harvested. There are many locations in this country and Canada where the mill buildup runs into thousands of tons per day.

Of the nine million tons per year of organic material in spent liquors from wood pulping—probably the wood waste receiving most industry attention—the percentage used for chemicals is almost negligible. The rest is simply dumped, or burned for fuel and recovery of inorganic cooking chemicals. About the only noteworthy volume chemical use for sulfite liquor lignins is the 20,000-30,000 tons/yr. which goes into carbon black substitutes for rubber reinforcement.

▶ **Too Big to Swallow**—Need for volume markets is made more urgent by the particular nature of the pulp and paper industry, forced by accident of birth into the role of patron saint for silvichemicals. Pulp, paper and other wood products are made in such large quantities that complete chemical utilization (in the name of economy) of the wastes would in many cases swamp world markets, let alone the American market, for any of the chemical components involved.

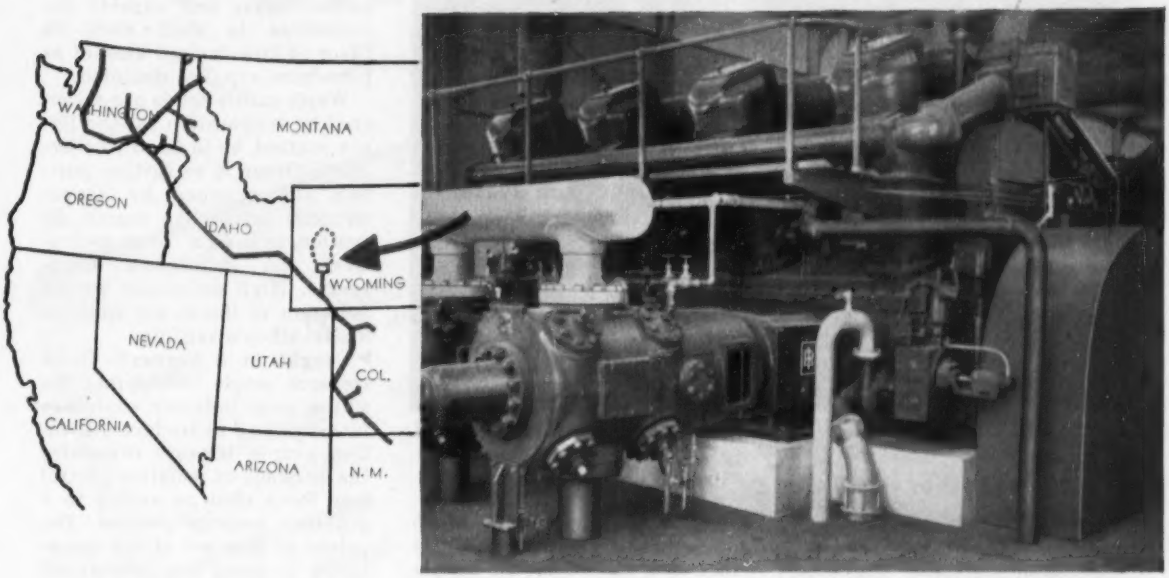
• For example, Crown Zellerbach last year made a big silvichemical splash with dimethyl sulfide from Kraft waste liquor. CZ's 2-million-lb./yr. pilot plant at Camas, Wash., is now converting a laboratory process into a commercial venture.* But right

*Crown will do more than recover dimethyl sulfide and methyl mercaptan from Kraft liquor for sale; it also plans to make derivatives from both, use them as first stepping stones into the synthetic organic chemical industry.

Silvichemicals for Sale

Vanillin
Dimethyl sulfide
Rubber reinforcers
Bioflavenoids
Oil mud dispersants
Ethanol
Antioxidants
Plastic extenders
Emulsion stabilizers
Ceramic binders

A NEW HIGH FOR I-R GAS-ENGINE COMPRESSORS



One of seven KVG Gas-Engine Compressors at Big Piney Station of Pacific Northwest Pipeline.

Seven KVG Units at 7,325 ft. altitude deliver gas from BIG PINEY FIELD to Pacific Northwest Pipeline

The Big Piney Station of the new Pacific Northwest Pipeline system is of special interest for two reasons.

Located at an elevation of 7,325 ft above sea level, it is the highest pipeline compressor station in the country—operating in temperatures ranging down to 40° below zero.

It has made possible the commercial utilization of Big Piney Field, which has been shut in for the past 18 years by lack of transportation facilities.

Hence it was quite appropriate that opening ceremonies for the Pacific Northwest Pipeline were held at Big Piney—where seven Ingersoll-Rand KVG Gas-Engine Compressors boost field gas to pipeline pressures. Two 880-hp units and two 660-hp units operate with intake pressures of 100-350 psi and discharge pressures of 400 to 550 psi. Three more 660-hp units have intake from 400 to 550 psi and discharge pressures of 650 to 850 psi.

Because of the extremely high altitude, the gas engines were supplied in bigger-than-normal sizes. Combined rated horsepower of the seven Big Piney units would be 5,060 hp at normal 1,000 ft altitude—for an actual load of about 3,885 hp under average conditions. The station is completely "winterized" for dependable operation at sub-zero temperatures.

Ingersoll-Rand Gas-engine Compressors now serving the various stations of the Pacific Northwest Pipeline include the following types and sizes:

5VG compressors, 330 hp
KVG compressors, 660 and 880 hp
Turbocharged KVS units, 1000 and 2000 hp
PKVG Gas Engine Power Units, 1100 hp

For maximum stability, flexibility and long-range economy under all pipeline conditions, it pays to specify Ingersoll-Rand four-cycle gas-engine compressors. Your I-R representative will gladly give you complete information on the units best suited to your needs.

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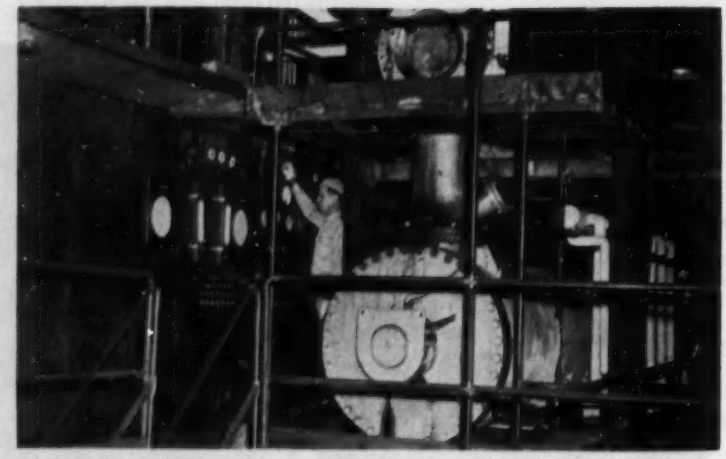

ALKALINE COOK in digester frees chemical values from redwood bark.

now the kraft industry could turn out, with no strain, over 700 million pounds of dimethyl sulfide a year.

• Rayonier has in its myricetin (from bark) what seems to be a promising bioflavenoid. But even if myricetin were widely adopted for use in cold remedies, its market would be tiny—albeit a profitable $1/lb.-one—compared to Rayonier's "normal" markets (measured in thousands of tons). Thus the firm is a little reluctant to push the project to hard, fears getting into an operation of an entirely different order of magnitude than it is used to—and Rayonier is perhaps the most chemically-minded of the pulp and paper companies.

• Weyerhaeuser is currently selling about 10,000 tons/yr. of Silvicon, its physically fractionated Douglas fir bark. It could produce 60,000 tons/yr. at its Longview, Wash., mill alone.

• Marathon Corp. has recovered vanillin from sulfite waste liquor for more than 20 years. But the market for vanillin as a food flavorant is peanuts in the eyes of the pulp industry. All demand could be met by one plant operating part time.

▶ **Unfamiliarity Breeds Inertia**—In general the forest products industry has neither the disposition not the experience that builds volume markets for specialty items. Unlike the chemical block, it is unused to spending the kind of money for process and market development which would make silvichemicals pay their own way. That the temper of even the most progressive industry faction inclines to the negative view is reflected in the statement of a Crown Zellerbach spokesman:

"In terms of tonnage, dollar volume, stability of market, profits and what have you, the chemical activities of any major pulp and paper company are, and will continue to be for the foreseeable future, but a small fraction of its pulp and paper operation. So its a question of gearing our (chemical) operation to the pulp and paper operation, not vice-versa. Just as we get a (chemical) process and product rolling, the pulping operation is changed, which, of course, gives us an entirely different raw material to work on (for chemical recovery)."

▶ **Spotlight on Sulfite Liquor**—Much of the activity in chemical recovery from wood—which represents progress, though scattered and relatively small—is still based on utilization of waste sulfite liquor.

Crown Zellerbach is isolating beta-conidendrin from sulfite liquor on a small industrial scale and marketing it as an antioxidant in fats, oils and rubber. Market development price is $3/lb., but in commercial quantities the price can probably be shaved to about $1.50/lb.

Puget Sound Pulp and Timber Co. manages to make alcohol economically from waste sulfite liquor and expects the economics to shift more in favor of tree-derived alcohol as petroleum supplies diminish.

Waste sulfite solids are recovered by evaporation for the lignin content, as in Crown Zellerbach's Orzan A, or further purified and changed by simple chemical action like caustic digestion, as in CZ's Orzan derivatives and Marathon's Marasperse. High molecular weight polymers in lignin are split, as in Marathon's vanillin.

▶ **Caught in a Corner?**—Some research people believe that the sulfite pulp industry continues investigating byproduct utilization simply because otherwise the demands of pollution control may force them to switch to a different pulping process. Deprived as they are of the opportunity to dump any substantial volume of organic waste material into water courses, the sulfite pulpers can justify, in the name of self-preservation, recovery of chemicals on something worse than a break-even basis.

These same research people also believe the cause of effective lignin utilization would be better served by employing wood itself as the primary raw material. If approached via whole wood rather than waste wood, lignins can be tailor-made for specific end uses. This enables the investigator to dodge limitations imposed when he is compelled to work with "cast-off" lignin, a product which gives difficult-to-separate mixtures at best.

For the high reactivity of the lignin molecule, a natural complex carbohydrate, poses another barrier to silvichemical development. No matter what you do to the natural carbohydrates you change them. Furthermore, most of their intermediates are unstable and react in several different ways.

▶ **For Profit, Not Expediency**—Before the silvichemical industry can grow to its rightful stature, the wood products people will probably have to stop handling it with an air of stop-gap expediency and assume the broad-based, profit-seeking approach which the chemical

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industry has used so successfully.

One such approach has been suggested by Weyerhaeuser's research director Patnode: "The forest products industry will probably have to form a silvichemical complex. Much as the chemical industry is its own best customer, the forest products industry will have to become its own best silvichemical customer. Where it may not pay to extract myricetin alone, it might pay to extract a whole fraction of chemicals: myricetin, quercitin, dihydroquercitin, polyphenols (2-7 rings), waxes and other organic extractives. One company might develop a process (and market) for one fraction, another for another fraction."

This will take a lot of exchanged know-how, a lot of close coordination. But the promised rewards could very well be tremendous.

Research Spending: High by Any Measure

	% of Sales	% of Profits	% of Capital
Pharmaceuticals	4.8	21.1	36.8*
Chemicals	2.8	15.3	25†

*Ciba Pharmaceutical Products
†Chem. Eng. estimate

How Much for Research?

As percent of sales, it seems considerable; of profits, impressive; and of capital effort, eye-opening.

That industry spends plenty for research today is not news. But it may come as a surprise to you, accustomed as you are to hearing research expressed as a percent of sales, to know how much of a company's total capital effort is for research.

Mr. T. F. Davies Haines, president of Ciba Pharmaceutical Products, Inc., takes a look at research spending in a talk he gave last summer at Columbia University's Seventh Annual Conference on Industrial Research.

▶ **Drugs Lead Chemicals**—Sifting research statistics of the past five years for eleven widely-known pharmaceutical companies, Mr. Haines reports that Schering Corp. spent 10.7% of sales on research (Ciba topped 7% in 1955). The mean for all eleven was 4.8% of sales.

Of 17 chemical companies on the New York Stock Exchange, the top research spender shelled out 5.3% of sales. Mean for the group: 2.8%.

Using another measure of research effort, Haines says one pharmaceutical company (Schering again) spent 33.7% of its net income before taxes on research in one year.

Mean expenditure for the eleven drug companies was 21.1%; for the 17 chemical firms, 15.3%.

Haines turns to his own company to illustrate the bite research takes out of a company's capital resources. Ten years ago only 12% of Ciba's employees were in research; today 19% are. During the same period the research payroll's share of total payroll rose from 14 to 20%. And ten years ago only 12% of Ciba's total fixed assets were used for research purposes; today research claims 35% of fixed assets.

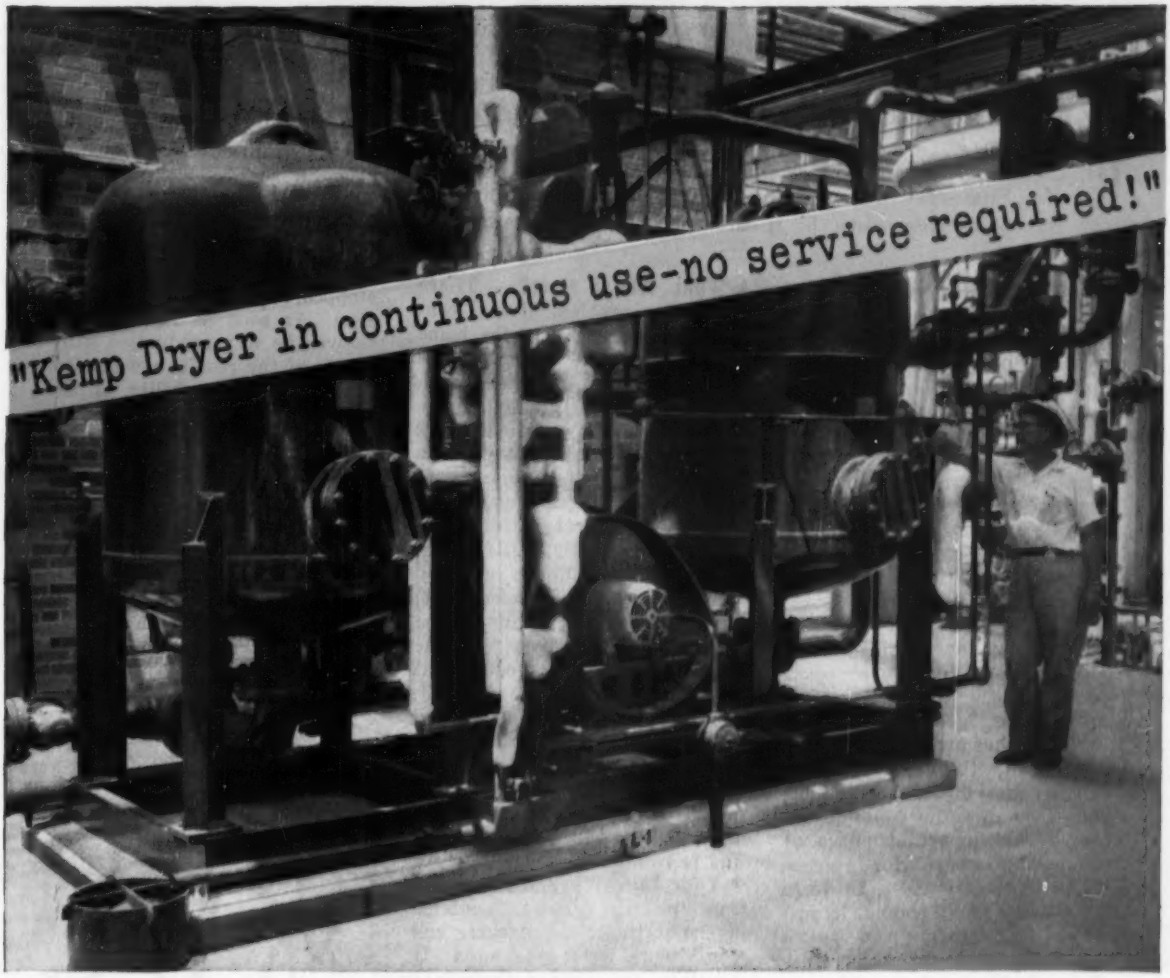
▶ **Are Sales a Good Basis?**—Percent of sales spent on research does not, feels Haines, have practical significance, at least for planning a research program. A company's sales volume doesn't necessarily have anything to do with how much money it can make available for research. Gross profit margins vary greatly in different branches of the chemical industry and even between pharmaceutical companies whose business may be more concentrated in one type of product than another.

On a dollar-and-cents basis, too, pharmaceutical research spending is impressive. One of the eleven firms mentioned above, Merck, spent $8.5 million in 1955. In the same year Pfizer spent $7 million; Ciba, $5.5 million; and Squibb and Smith, Kline & French, each $5 million.

Ciba's Haines runs down the price list to show why research costs the drug industry so much.

- Its easy to put a quarter-million-dollars worth of equipment into a single laboratory.
- A suitable building with equipment to study high pressure reactions can cost even more.
- A pilot plant for any worthwhile research program in antibiotics and fermentation chemistry costs several million.
- Every PhD engaged in research needs $75,000 worth of buildings and equipment around him. Laboratory costs alone (for depreciation, maintenance, lab assistants, stock room cost, etc., but excluding research administration, outside grants, library and patent expenses) average $45,000 a year for each PhD in research.

▶ **Costly Misses**—Even so, most drug research (and this is what really runs up the tab) ends in failure. Only four antispasmodic drugs are widely used out of the many hundreds tested and classified. More than 5,000 analgesics have been discovered but only eight are commonly used. Only three or four compounds have been found successful out of the more than 14,000 chemicals tested for antimalarial activity. Fifty-five scientists spent 2½ years screening more than 100,000 soil samples to get just one of the broad-spectrum antibiotics. Cost: $4 million. (Only 76 out of 100,000 soil samples showed any antibiotic activity at all.)



Cities Service Petroleum reports:

Kemp Dryer in continuous operation 7 days a week; has required no service or downtime!

To dry compressed air for instruments in a hydroformer unit at its refinery in Lake Charles, Louisiana, Cities Service Refining Corporation has installed a Kemp Model LC SE2 Air Dryer. Since January, 1955, it has served continuously—seven days a week—drying 1900 cubic feet of air per minute to a dew point of −10° F.

This fully automatic Kemp Dryer, reactivated every 12 hours (or 22,800 cubic feet of air), has so far required no downtime or service at all! And, according to Mr. Glendon L. Smith, Unit Engineer at Cities Service, there is practically no pressure drop from the entering pressure of 285 pounds . . . further indication of Kemp quality and efficiency.

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ECONOMICS . . .

How to Handle Outside Research Projects

Engineers may get the job of on-the-scene piloting of outside research. It calls for coordination and tact.

You may find yourself someday directing an outside research project—one that has been "farmed out" for any of a number of reasons.

At Elgin National Watch Company, for example, a qualified engineer from the home staff is assigned the responsibility of piloting outside research work, according to a recent talk by Research Director George Ensign at the National Industrial Research Conference.

H. G. Wells foresaw an age when every key administrative position would be held by engineers and scientists. We aren't sure if this "golden age of the engineer" has arrived yet, but if tomorrow is the day, you ought to know some of the thought that goes into directing outside research—an important phase of conducting research for profit.

▶**The Project Itself**—Projects for outside study should, if possible, lend themselves to a long term treatment. Experience shows that long relationships are the most productive. It takes time to get acquainted, to develop understanding and compatibility. We'll assume the project for outside study has been chosen properly—that's the job of the research director. His reasons may be that the company's research staff is too small or the nature of the problem lies outside the particlar talents and equipment in the company's own labs. Outside facilities may make available to you more millions of dollars worth of equipment and trained operators than your company could dream of purchasing.

NEXT MONTH

CHEMICAL PESTICIDES

Evaluating pesticide performance in this transitional year and outlook for 1957.

▶**What About Cost?** — There will be no problem of cost control unless created by the home office. The outside labs will discuss the budget with your company in advance. These final figures become law the moment authorized expenditures start. In some cases outside project costs have been easier to control than costs on a project in the home labs. If the cookie jar is out of reach it won't tempt as often.

With any specific agency the costs will vary depending on the scientific talent required, the type and quantity of equipment needed, the space, amount of supplies, travel expense, power and other items to be considered.

Estimated figures of $1,200 to $1,500 per month per research worker assigned to your project are good enough to use, according to Elgin's Ensign.

▶**Your Job**—When your project was placed with an outside agency, their reputation and competence were considered. If possible, you visited their labs and met the men who might be assigned to your problem. The location of the outside facility should be given a lot of weight. Close liaison between the home staff and the working group is a must.

Your job is a close, continuing, personal, on-the-job direction to insure maximum effectiveness in using the outside facility. You will probably have to keep in constant contact with a man in the home laboratory by letter, phone, reports and personal visits. The project scientist should keep you fully informed of his progress and troubles so that your company can assist him when needed and keep the project on course.

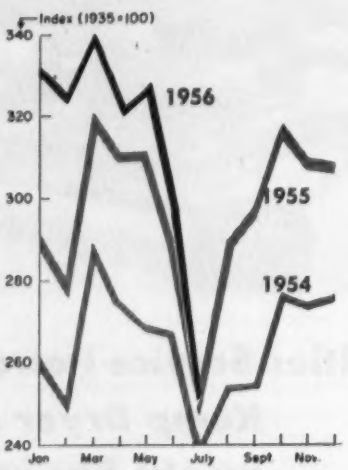
▶**Simple Reports Favored**—The subject of reports is frequently raised. The sponsor can receive any kind of report he wants—from a simple monthly letter to a detailed technical report.

The best kind seems to be the simplest working report that adequately describes progress and outlines future activity. Detailed records for patent use and as true technical reports must be kept in laboratory notebooks. There is no need to repeat volumes in the formal report.

▶**Stopping The Project**—Usually a successful project is not stopped, it is weaned, says Ensign. As soon as research has shown the way production utilization of the results are started. It is the responsibility of the home research organization to recognize this time and to recognize the time when further lab work is not needed.

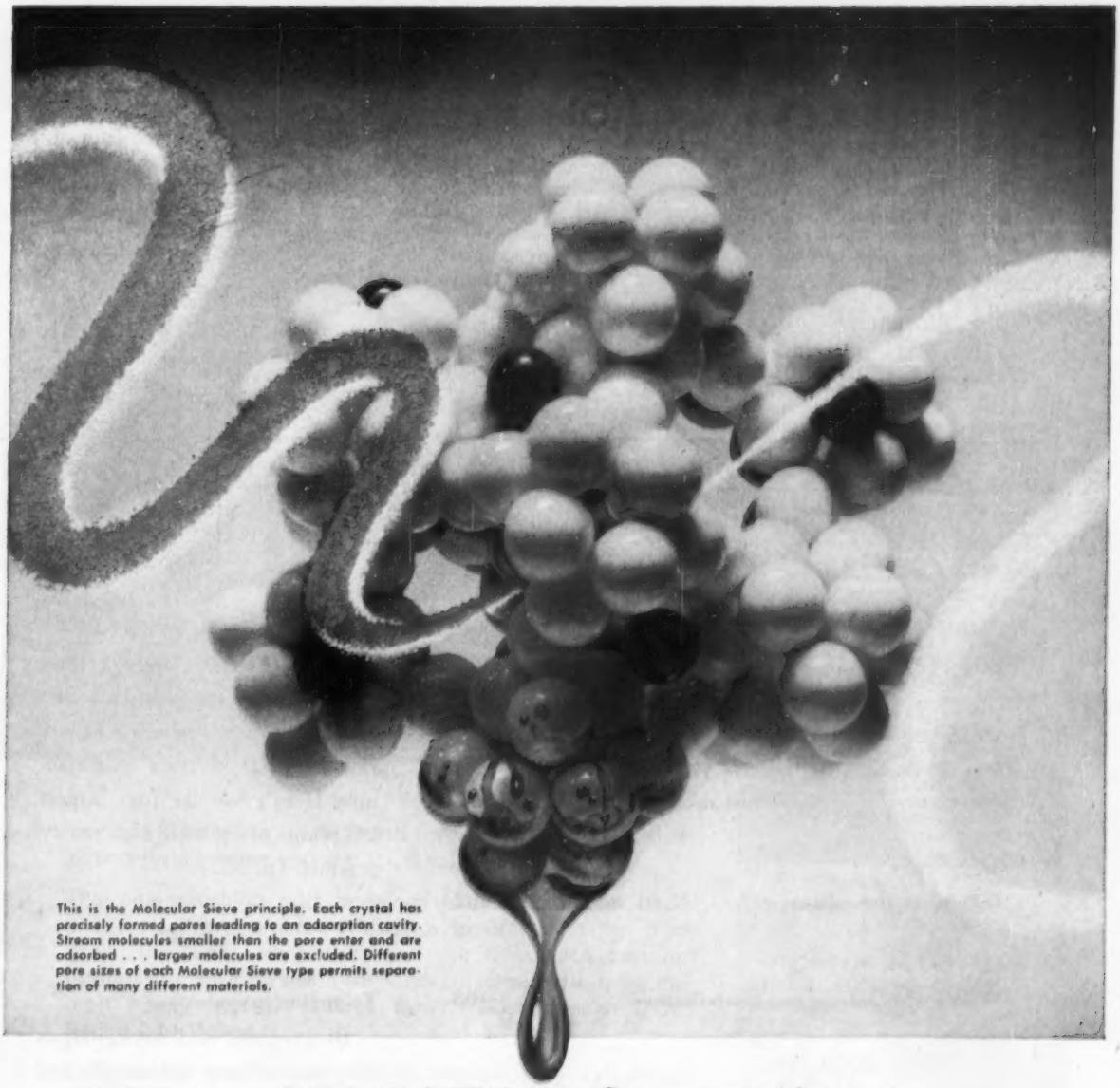
When an outside project fails—and it happens—it's usually a little noisier than a failure in the home labs. Funds are cut off,

Chemical Consumption



Consumption by Industries

	June (Final)	July (Est.)
Coal products	11.4	3.5
Explosives	11.9	10.1
Fertilizer	56.5	45.6
Glass	27.6	26.7
Iron & steel	17.8	3.0
Leather	4.1	4.1
Paint & varnish	35.2	32.2
Petroleum refining	31.5	32.3
Plastics	22.7	19.5
Pulp & paper	37.8	34.5
Rayon	24.9	24.7
Rubber	6.1	5.3
Textiles	9.1	8.5
Total	297	250



This is the Molecular Sieve principle. Each crystal has precisely formed pores leading to an adsorption cavity. Stream molecules smaller than the pore enter and are adsorbed . . . larger molecules are excluded. Different pore sizes of each Molecular Sieve type permits separation of many different materials.

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For a descriptive booklet, "Molecular Sieves for Selective Adsorption," write Dept. CG-11, Linde Air Products Company, A Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.

Linde TRADE MARK MOLECULAR SIEVES

The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation

termination reports come in. But if the project has had adequate direction, stopping it is no more a problem than stopping a failing project at home.

▶ **Results Usually Good** — Experience shows that if you do your part you will get more than adequate "best efforts" from the outside labs.

Outside research facilities offer an exclusive relation to the sponsor, your company. They honor the confidences that must exist between their staff and the sponsor and accept only one sponsor in a particular field. Their work in this field is available to a sponsor exclusively and includes delivery of patent rights, control over publication of papers and even reference to the nature of work being performed.

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

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Talent on parade

Biographies and backgrounds of your authors and weight and importance to their contributions in this issue. (p. 408)

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You can get—free and fast—literature on any subject in your field. Keep files up to date the easy way. (p. 470)

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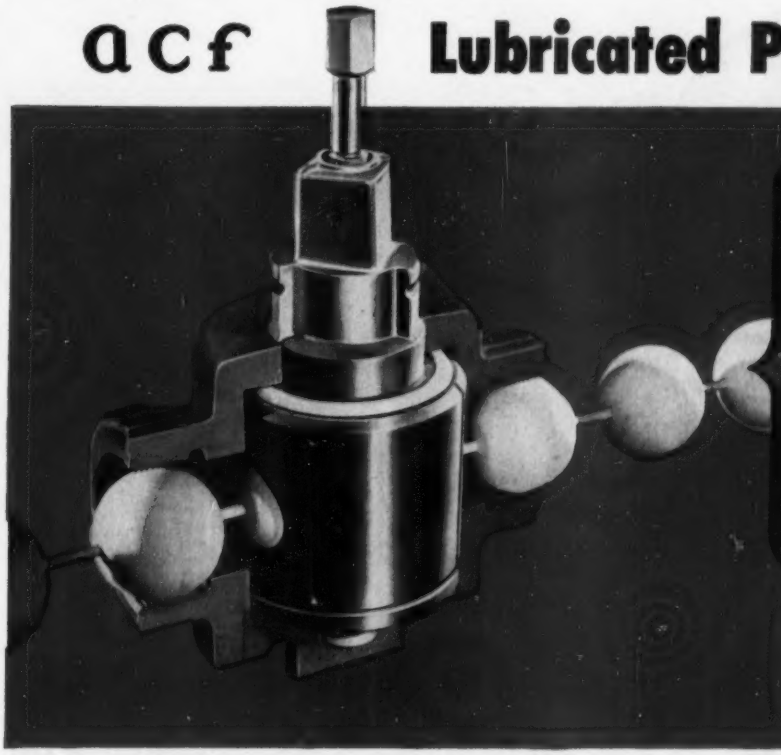
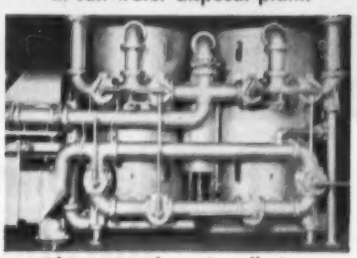
Inside Back Cover

acf Lubricated Plug Valves



ROUND PORT MEANS FREE FLOW ALL THE WAY

In salt water disposal plant.



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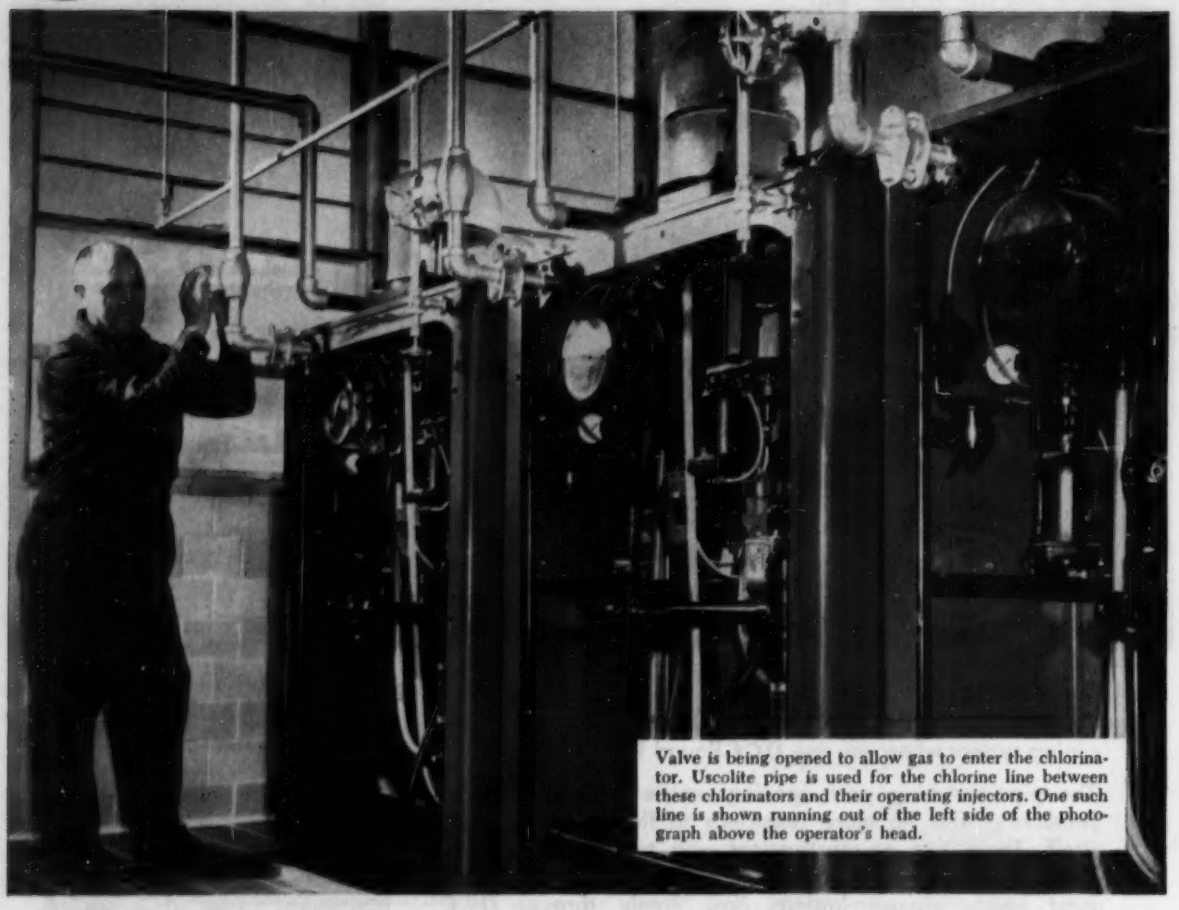
acf LUBRICATED PLUG VALVES

KEY RETURN BENDS AND FITTINGS

USCOLITE PIPE



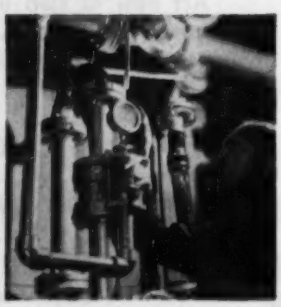
Valve is being opened to allow gas to enter the chlorinator. Uscolite pipe is used for the chlorine line between these chlorinators and their operating injectors. One such line is shown running out of the left side of the photograph above the operator's head.

For flexibility, corrosion-resistance and durability in handling chlorine

this sewage plant relies on chlorinators equipped with Uscolite Pipe

"That's because the highly corrosive chlorine does no damage to Uscolite", says an engineer with Wallace & Tiernan Inc., makers of the chlorinators used in the Westchester County Sewage Disposal Plant, New Rochelle, N. Y. Wallace & Tiernan say they find Uscolite Pipe excellent as a carrier of moist chlorine gas and chlorine solutions. They are constantly extending its use for chlorine solution lines at their installations.

Uscolite® plastic pipe is extremely light in weight, yet has very high impact strength. It will resist acids, salts, alkalies and gases, inside and out. Uscolite has the seal of approval of the National Sanitation Foundation. Completely new or replacement piping—plus a wide variety of pipe fittings, valves and sheet, slab and rod stock—all are obtainable at any of the 28 "U.S." District Sales Offices, at selected distributors or by writing us at Rockefeller Center, New York 20, N. Y. In Canada, contact Dominion Rubber Co., Ltd.



(At right) Reading dial on an operating injector. Pipe leading to left and up is Uscolite.

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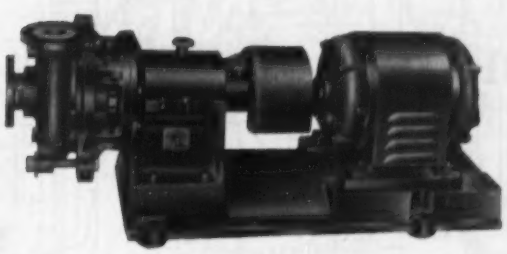

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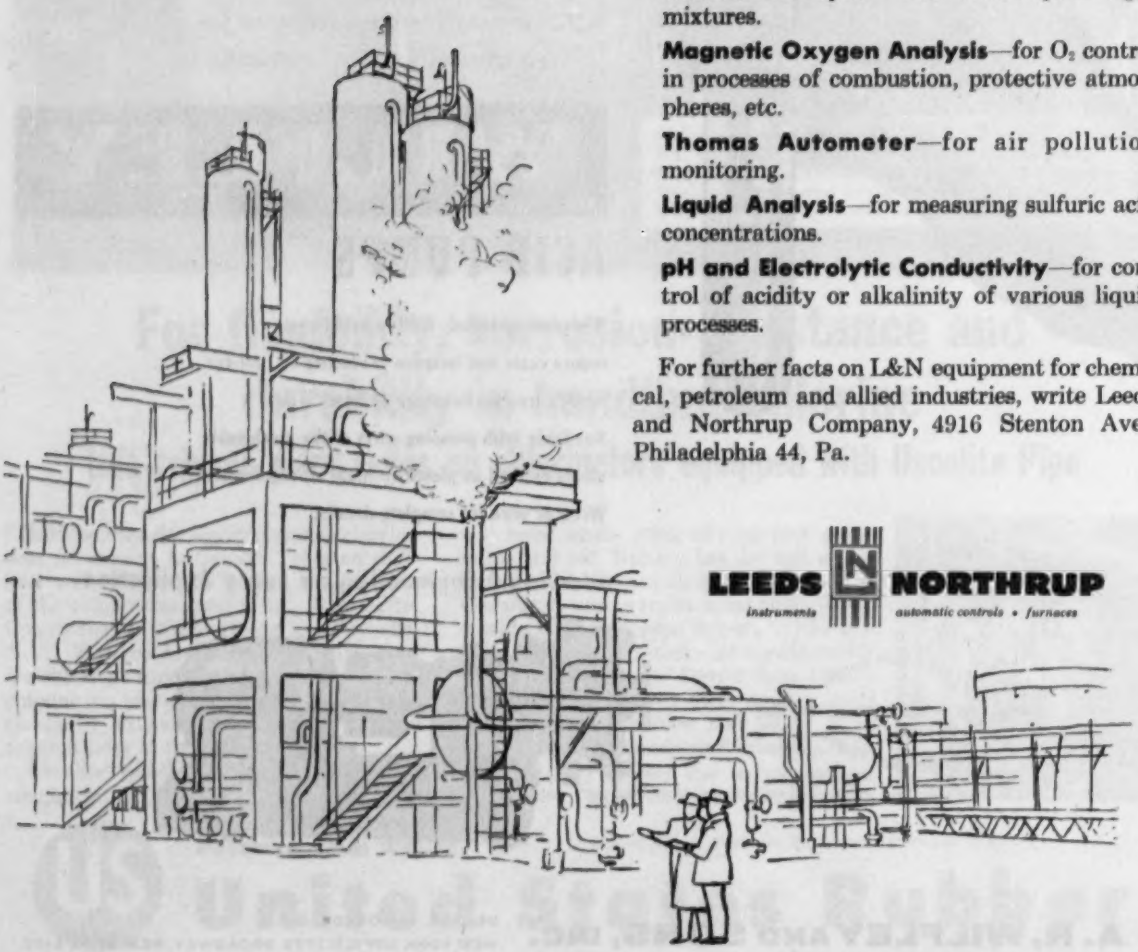

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LENGTH OF FILTER CYCLES

Filteraids are commonly rated as to effectiveness in terms of flow rate and clarity. For many filter press applications, however, cycle length is equally important. This is increasingly true as labor rates rise each year, so that the cost of press room labor becomes a larger and larger burden on the operation.

Cycle length is generally limited by declining flow rate towards the end of the cycle. In certain systems where high specific resistance cakes are formed, it may be necessary to terminate the cycle before the press is filled in order to maintain an average rate high enough to meet production demands. For most systems, however, cycle length can be extended to minimize labor costs. Three factors are of prime importance.

First, select the proper grade of filteraid. Filtration rates may be increased several-fold by employing the filteraid whose particle size range matches the filterable solids being removed. This insures freedom from migration of fines through the cake to blind the cloth and yields maximum filtrate volume per press cycle.

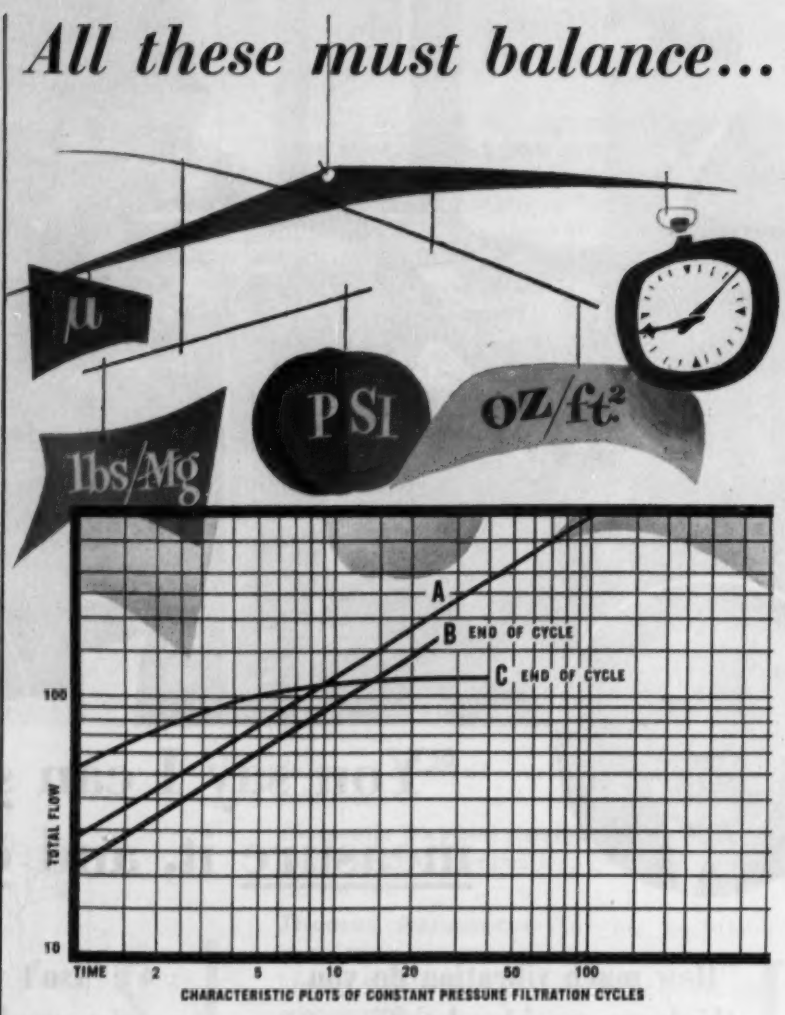
Second, select a filteraid of high quality. It is generally known that superior air classification is the heart of the filteraid manufacturing process. Few people realize that diatomite filteraid plants represent investments of millions of dollars, and include exceedingly complex air classifier circuits. In our modern plant at Lompoc, California, for example, the product passes successively through fourteen cyclone separators. These are all of highly specialized design, based upon twenty-five years of experience, and are not available to industry from the suppliers of standard dust collector equipment. High quality filteraids hold flow rate decrease to the theoretical 0.5 slope. Poor quality filteraids, though often possessing high initial flow rate (due to coarseness) tend to "tail off," as the cycle progresses.

The third important factor in extending press cycle length is to use the optimum percentage of filteraid. In many instances cycle length is limited through the use of excessive amounts of filteraid, thus filling the press prematurely and terminating the cycle. On the contrary, some customers use insufficient filteraid to maintain the desirable 0.5 slope.

In conclusion, filteraid technology is neither mysterious nor "arty." The selection of the best filteraid for most effective filtration can be established by carefully controlled tests. Claims for super performance should be viewed with suspicion, particularly unless claims are backed up by reliable data obtained either by technically sound laboratory tests (not slanted either deliberately or inadvertently through the selection of improper test conditions) or by actual plant scale test runs. Dicalite filtration engineers are fully competent to render this service. Their assistance is freely available. Don't fail to take advantage of this to improve your filtration efficiency.

P. W. Leppla, Technical Director

All these must balance...



CHARACTERISTIC PLOTS OF CONSTANT PRESSURE FILTRATION CYCLES

for MOST EFFICIENT FILTRATION

These plot lines, established in actual tests under plant conditions, clearly point up the importance of balancing *all* the filteraid factors — particle size; particle size range and distribution, precoat and body feed requirements. Line A shows the satisfactory flow rate and long cycle length obtained with such balance. Line B shows the result of too much filteraid — lower flowrate and short cycle, due to rapid filling of the cake space in the filter. Line C demonstrates the results of either insufficient filteraid or too coarse a filteraid; note the rapid drop in flow rate and the short cycle caused by solids blinding the filter screen.

For most efficient filtration, Dicalite provides a complete range of dependable, uniform filteraids to meet the requirements of practically any filtration. And Dicalite service engineers, working in your own plant, can help you "balance" your filtrations for highest clarity, optimum throughput and longer cycles.

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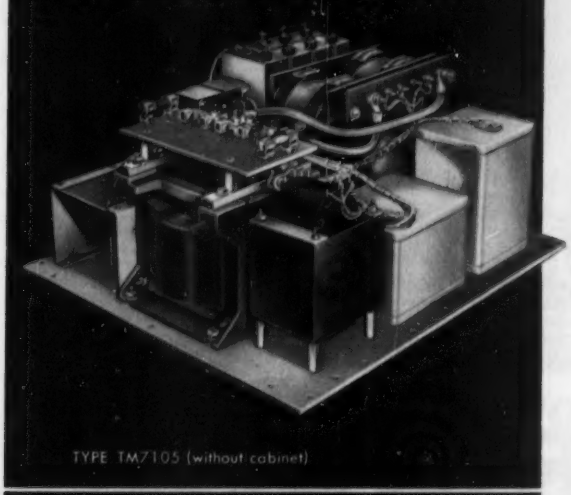

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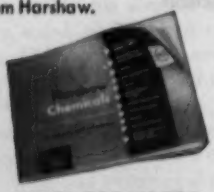

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- Chemical Commodities

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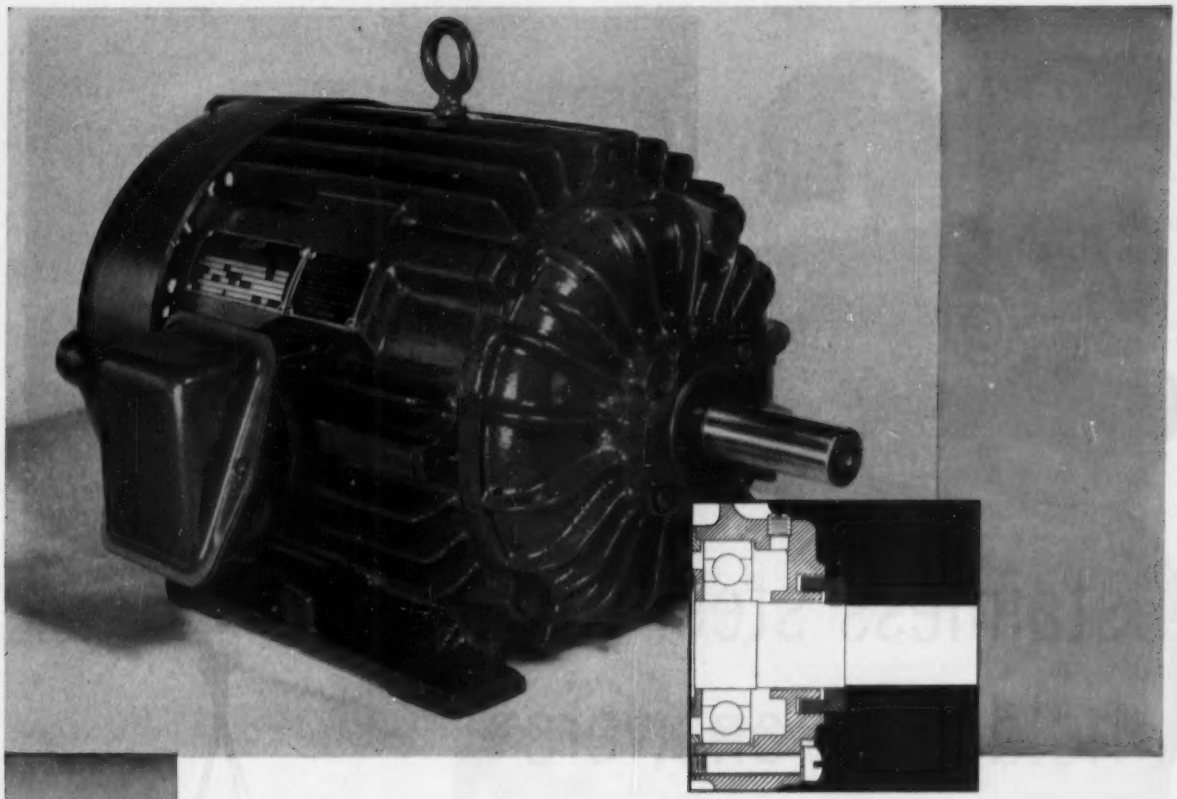
1945 EAST 97th STREET • CLEVELAND 6, OHIO

Chicago • Cincinnati • Cleveland • Hastings-On-Hudson, N.Y. • Houston • Los Angeles Detroit • Philadelphia • Pittsburgh



Securely sealed for low maintenance —

Century

TOTALLY ENCLOSED FAN COOLED MOTORS

When motor maintenance goes down, production goes up. Century TEFC Motor *protects itself* from dust, grit, chemical fumes, moisture. Shaft openings at each end are labyrinth-sealed, and there is a precision clearance between metal seal and bearing bracket.

Outside, a hose or whisk broom quickly cleans it. External fan forces jets of cooling air across the frame. Inside, vital motor parts are completely sealed off from injurious atmosphere. Factory lubrication of bearings is adequate for several years' service under normal conditions; however, whenever required bearings may be relubricated through grease plugs.

For full facts on your specific application, call the Century District Office or Authorized Distributor nearest you.

CENTURY . . . building TEFC Motors for 25 years

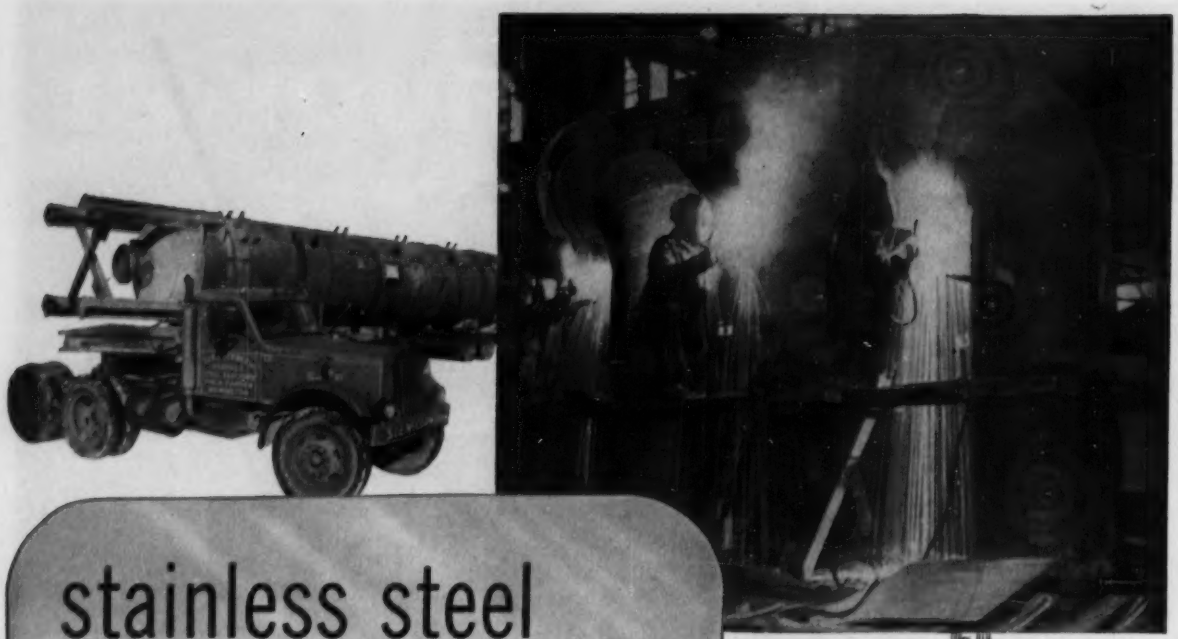
CE-44

Performance-Rated®
MOTORS
1/20 to 400 H.P.

C

CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri • *Offices and Stock Points in Principal Cities*



stainless steel holds the answers

Every industry that works with steel has its special problems of the proper steels for every job . . . more and more industries are finding that Stainless "holds the answers" to their problems.

Take the petroleum and chemical industries for instance. They demand resistance to corrosion, to abrasion, high temperatures, cold temperatures, scaling and hydrogen blistering. Solid stainless can do the job. But, in some equipment, stainless cladding can answer the problems . . . and cut costs as well.

Sun Ship knows how to fabricate stainless and the other special alloys. They have the facilities and experience. Large jobs or small jobs will receive prompt attention.

Our Sales Engineering Department will be glad to discuss with you any problems to which our Alloy Products Shop may hold the efficient and economical answer.

ALLOY PRODUCTS SHOP

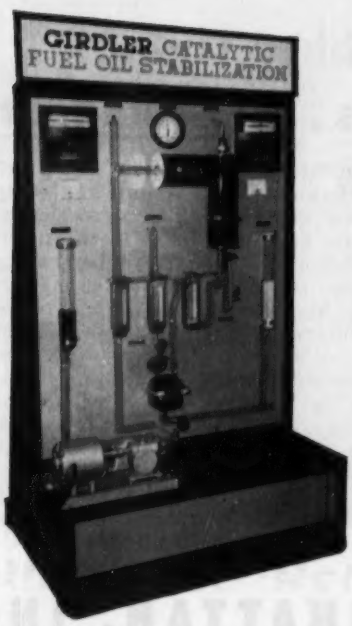
OF SUN SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • CHESTER, PA. • 25 BROADWAY, NEW YORK CITY

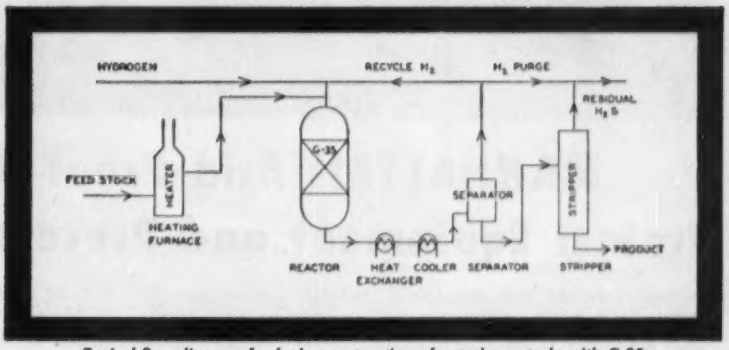
NEW GIRDLER CATALYSTS

G-35

commercially proven for upgrading petroleum stocks by hydrogen treating



A unit for demonstrating the performance of Girdler G-35 Catalysts on customer feed stocks.



Typical flow diagram for hydrogen treating of petroleum stocks with G-35.

● Naphthas, middle distillates, and gas oils can all be upgraded by hydrogen treating with the use of new Girdler G-35 Catalysts. These highly active cobalt molybdenum catalysts were developed specifically for the desulfurization, denitrification and stabilization of petroleum feed stocks covering a wide molecular range.

Improvement of color, stability, octane rating and burning characteristics and the removal of poisons for catalytic reforming are among the important results achieved.

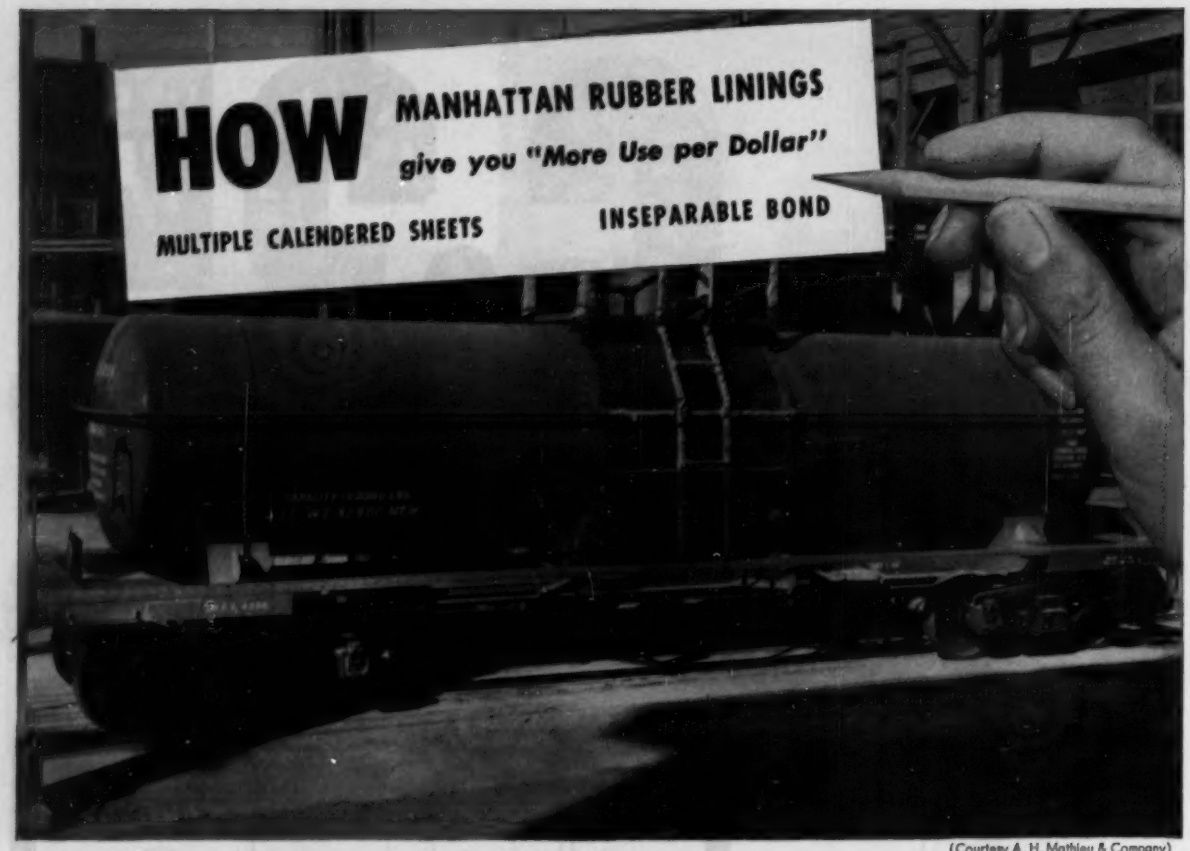
Girdler G-35 Catalysts feature outstanding physical properties which are retained—even after repeated regenerations and use. Permit outstanding operational flexibility, continuous economical operation with essentially 100% yields.

For detailed information on the new G-35 Catalysts, simply write The Girdler Catalyst Department.

CATALYST DEPARTMENT

The GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY



(Courtesy A. H. Mathieu & Company)

MANHATTAN Acid-Proof Rubber Linings Protect Equipment and Processes... Permanently

Corrosive acids, salt solutions and other chemicals require the kind of permanent protection possible with specially compounded, acid-proof Manhattan Rubber Linings. They are made from thick, multiple calendered sheets of natural or synthetic rubber that expand and contract with the metal under temperature changes. They won't harden, crack or break under normal conditions of use. An exclusive Manhattan process bonds the rubber lining to the metal so securely that actual tests have proved they can't be separated! This gives you *real, positive* protection against corrosion and abrasion of your equipment, and against contamination of your process solutions. Resistance to most acids, caustics and alkalis is as fool-proof as the most advanced lining compounds and methods can provide.

Manhattan has the most modern and complete lining facilities available today *plus* experience dating back to the first tank lined in this country. You can depend on Manhattan Rubber Linings to provide flawless, permanent protection. To make certain, every Manhattan Lined Tank is tested under high voltage to detect any possible imperfection before it is shipped to your plant. Equipment too large to be shipped can be custom-lined and vulcanized in the field by Manhattan specialists. Additional data about Manhattan Rubber Linings will be found in Manhattan's new Tank Lining Catalog #7115. Write for a copy today . . . or contact the R/M representative nearest you.

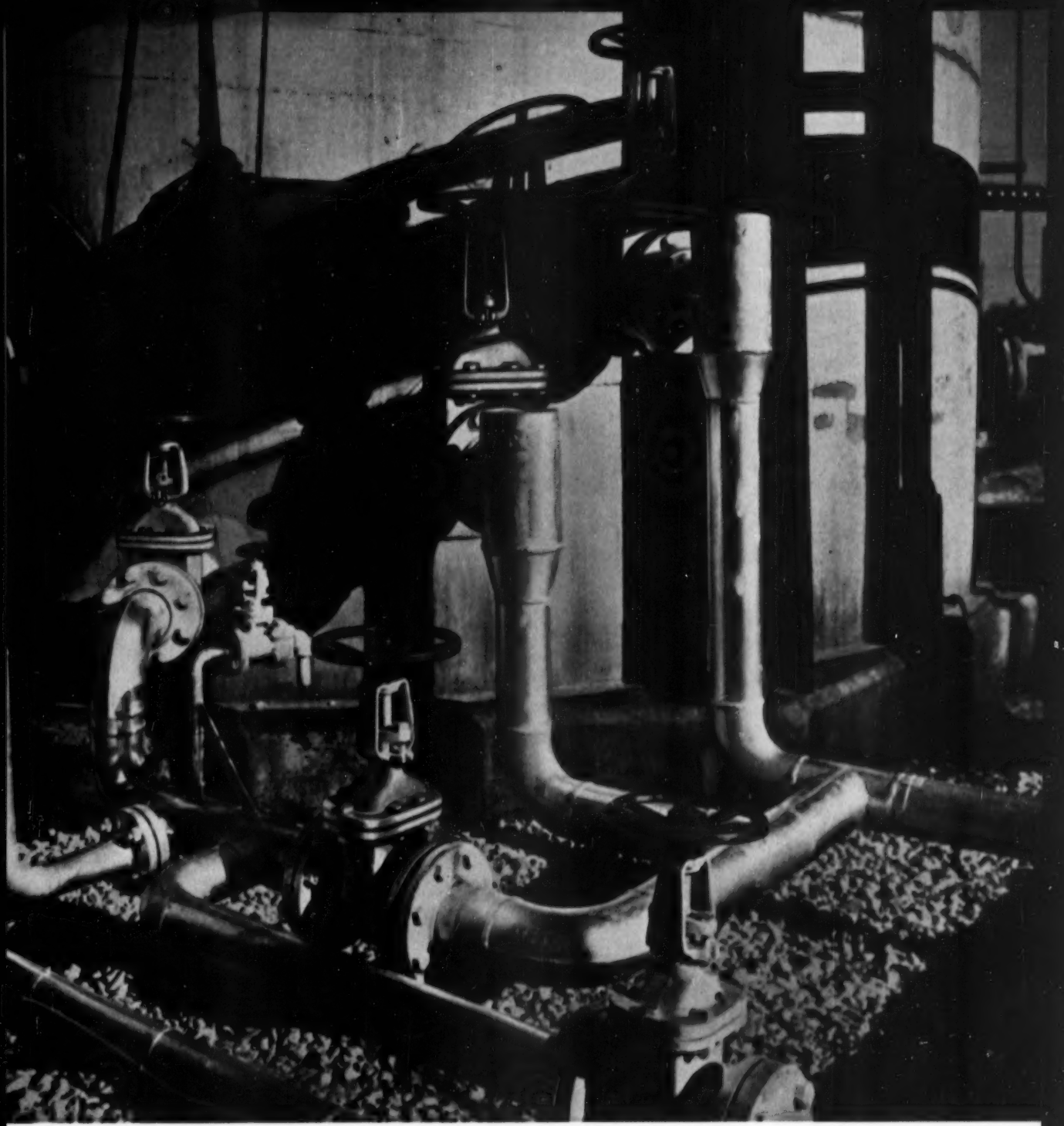
RM622

RUBBER LINING PLANTS AT PASSAIC, N. J. and NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls



Meet three synthetic detergent experts

You're looking at a Philadelphia installation of The Atlantic Refining Company (expert #1).

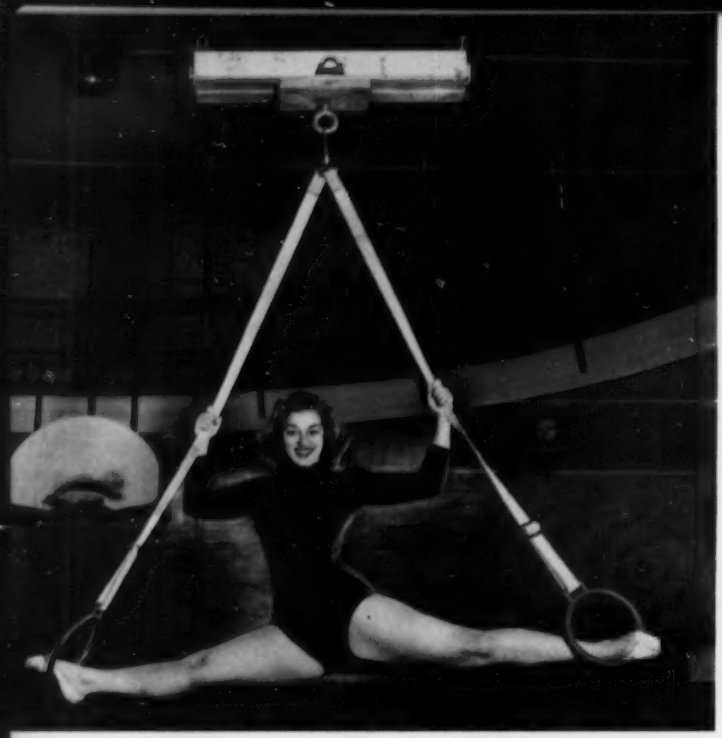
Ultrawet, an important ingredient of synthetic detergents, is the product being processed in this modern plant designed and built by The H. K. Ferguson Co. (expert #2).

Helping to prevent contamination of the product due to corrosion are long-lasting, red-wheeled valves made by Aloyco (expert #3). Made of corrosion-resistant Aloyco 20, the gate and globe valves used here handle a 98% concentration of sulfuric acid at up to 180° F.

Whatever your process, whichever corrosives you need to keep in line, it pays to check first with Aloyco. As the world's largest manufacturer of corrosion-resistant valves exclusively, we're most likely to have the valve you need. Write Alloy Steel Products Company, Inc., 1301 West Elizabeth Ave., Linden, New Jersey. 63

Subsidiary of Walworth Company

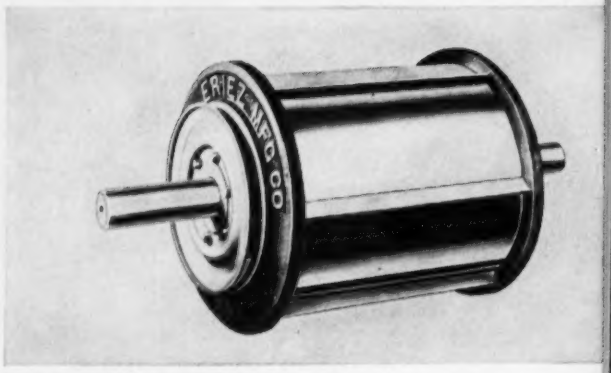
Magnetic ideas from ERIEZ



THE DARING YOUNG GAL ON THE ERIEZ TRAPEZE. Though she swings through the air with the greatest of ease, this pretty aerialist has nothing to worry about. Her rigging is held securely by an Eriez HI-POWR magnet, hung from the ceiling of the gym. This idea of herculean magnetic power has found a practical use in industry, where magnetic separators are used in processing lines to remove tramp iron that could cause fires, machinery damage and product contamination. *All Eriez HI-POWR Magnets are non-electric, self-contained. They operate without any wires or attachments. Their magnetic power lasts a lifetime. The first cost is the only cost.*

ERIEZ HI-POWR MAGNETIC SEPARATORS

ERIEZ HI-VI VIBRATORY EQUIPMENT

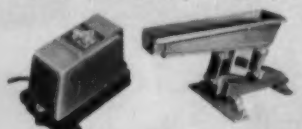


YOU CAN'T BEAT THIS DRUM. The self-cleaning Eriez Permanent Magnetic Drum is an unbeatable unit for automatically extracting tramp iron from materials conveyed in spouts, chutes, spiral conveyors, etc. Consisting of units with or without housing, the Eriez HI-POWR Drum is a revolving shell inside of which are powerful Alnico V elements which pull tramp iron from wet or dry material, thereby preventing possible fires or machinery damage . . . and assuring a contamination-free product. For more information on this product, request Bulletin B-601.

FABULOUS FERROTRAP FINDS FINES. Installed in a processing line handling a viscous liquid, this Eriez Magnetic Ferrotrap catches even the most minute particles of unwanted iron. Located just ahead of the mechanical filters and high pressure pumps, the Ferrotrap has eliminated pump and filter failure caused by iron contamination in the liquid. It has also cut maintenance costs by greatly reducing corrosion. Available in standard or sanitary models, Ferrotraps are ideal for removing microscopic fines from liquid lines where product purity is of prime importance. Ferrotraps can be installed in any position, to avoid sump effect. Magnetic element is quickly and easily removed for cleaning.

New! Eriez HI-VI VIBRATORY EQUIPMENT

First complete line of electro-permanent magnetic vibratory equipment operating at 3600 CPM directly off an AC line. No rectifier needed! . . . just plug in. Greater vibratory output with less power consumption. Less maintenance; lower installation costs. Permanently powered guaranteed Alnico V magnetic element (heart of the unit) produces an exclusive "double action" drive for more productivity.



Write for complete information on HI-VI Unit (bin) Vibrators to keep bulk materials flowing freely. HI-VI Vibratory Feeders for accurate, controlled feed.

Patent Pending

A POUND A DAY KEEPS THE REPAIRMAN AWAY. A 36" Eriez HI-POWR Plate Magnet at the Tetley Tea Company plant picks up about a pound a day of nails, bolts, screws and other tramp iron. The Eriez installation protects the bag machinery . . . *and* is saving about $5000 a year . . . *and* is saving about 200 manhours annually . . . *and* is increasing production! Besides the Plate Magnet shown, four other efficient Eriez Magnets have been in operation at the famous tea plant protecting product purity since 1950.

Eriez' free booklet "Magnetic Ideas" can help you. Send for it without obligation, ERIEZ MANUFACTURING COMPANY, 74L Magnet Drive, Erie, Pa. OR on your specific request Eriez factory-trained field men backed by Eriez' laboratory and engineering know-how, will be happy to study your particular problem, make a plant survey and offer helpful "Magnetic Ideas".

The risk is too great —clean it right

You don't take risks when men, equipment, and lost production time are involved. That's why more and more companies are investigating the methods and firms used in their chemical cleaning. They know it's work for experts.

What are they concerned about?

First, they want to know they are getting the benefits of experience. These benefits include less downtime and more thorough cleaning. Dowell has this experience with over 15 years and 10,000 boilers alone to their credit. In saving downtime, Dowell often cleans equipment while it is in operation.

Next, these companies want to be sure their men and equipment have the greatest possible protection. Dowell excels here, too. For safety is foremost in the Dowell engineer's mind. Thoroughly trained, he uses only the latest safety methods and equipment. He works closely with your safety personnel to establish safest possible working procedures.

Be sure you are getting maximum results with maximum protection in your chemical cleaning.

Call the Dowell office near you. Dowell engineers are ready to discuss and help you with your cleaning problems any time, at no obligation. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. K-33.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Inlet side showing cast iron inlet cone with integrally cast guide vanes. Fan is an Arrangement 9 package unit with monel wheel.

Drive side showing enclosed motor, belt guard and rain shield over ball bearings and shaft drive.

"BUFFALO" HIGH-EFFICIENCY CAST IRON FANS ARE SAVING MONEY ON CORROSIVE FUME INSTALLATIONS

Developed by "Buffalo" engineers to meet a specific request for high efficiency fans to operate under extremely corrosive condition, these fans combine cast iron durability with the well-known high performance of "Buffalo" Limit-Load® Fans. These No. 2½ Type "LL" Fans are popular with the chemical and process industries; one large manufacturer having over 1,000 units installed on chemical fume hood exhaust.

Rugged cast iron housings and cast inlet cones with integrally cast inlet vanes, guide air smoothly into the wheels, for the low-turbulence air flow inherent in this high efficiency design.

As with all "Buffalo" Fans, these have the famous "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

These fans have the backward curved blade wheel, non-overloading, regardless of system pressure. Standard wheels are monel but can be supplied in stainless or protective coated steel or of Everdur or aluminum for explosive atmospheres.

Three arrangements are available: with direct motor drive, separate belt drive or as a package unit with adjustable pitch V-belt drive and motor mounted on adjustable base rails.

Your inquiries on these rugged chemical-industry fans are invited. Write today on your company letterhead.

Roof exhaust installation at a major chemical and dye plant.

"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

For complete protection... against explosion, dust, rain... use

APPLETON

INDUSTRY'S MOST ADVANCED LINE

Circuit Breaker, Motor Starter and Combination Motor Starter

UNILETS®

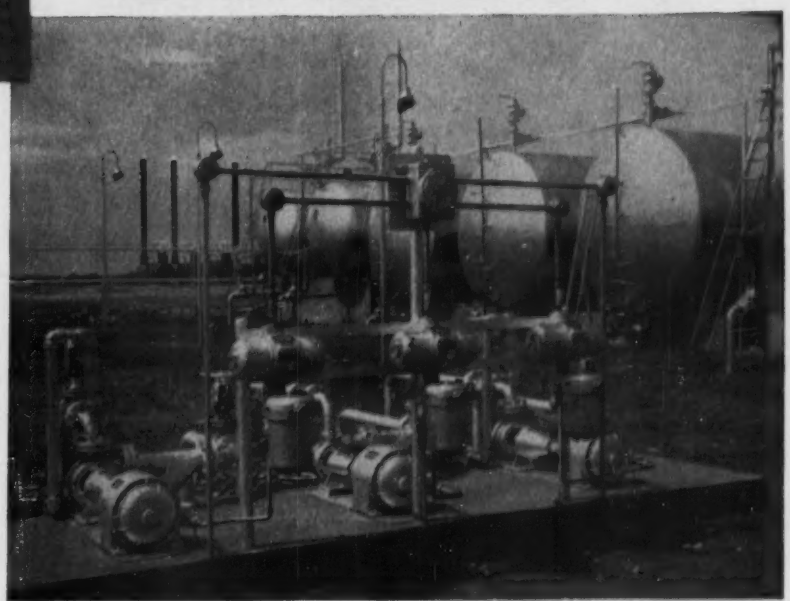


Photo courtesy Oil & Gas Journal

APPLETON Circuit Breaker and Motor Starter Unilets on tank car loading pump motors in field processing plant.

More TOP-QUALITY features!

- First to be U.L. Approved for banked circuit breaker grouping
- Combinations meet U.L. requirements through approval of components
- No shut-downs while entering motor starter of a combination
- Full 7-thread Explosion-Proof protection
- Unmatched accessibility
- Compact, lightweight construction
- Units may be added quickly, easily
- Flexible field set-ups with single and duplex male and female hub adapters

Also Manufacturers of:

The biggest advancement in Explosion-Proof design in years! The design, construction and performance of APPLETON Circuit Breaker and Motor Starter Unilets give you maximum safety and unparalleled ease of wiring, installation and maintenance. You'll discover initial and long term savings plus many exclusive APPLETON features, not found in any other enclosure.

Where absolute safety is required, regardless of the installation, APPLETON can serve you better! Send for Bulletin BH today for complete information!

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY
1742 Wellington Avenue • Chicago 13, Illinois

Rely on* APPLETON *... the Standard for Better Wiring

Any way you look at it

you get more mixer value per dollar from phillie gear

See the newest developments in Mechanical Power Transmission at our Booth #80—22nd National Power Show, New Coliseum, New York City, November 26-30.

Note easy accessibility to flange coupling and upper mixer shaft due to unique design of reducer support.

Ever see a mixer this big? Built for agitation of very viscous material in a vertical tank, the gear reducer alone weighs 9000 pounds. Driven by a 75 HP motor the 154 HP capacity of the gear unit provides a generous service factor for unusual operating conditions. The 7" diameter shaft is more than 16 feet long. When you're thinking of big mixers for any process—think of Phillie Gear.

While the illustration above shows a larger agitator than you may ever require . . . for any fluid mixing job, any process condition, or any kind of mixing, doesn't it stand to reason that a heavier, more powerful, better designed mixer will do more work for you, dollar for dollar, at less cost?

Here's how, size for size, unit for unit, Philadelphia Mixers give you more mixer value per dollar invested.

(1) Philadelphia offers more horsepower capacity per dollar: All reducer drives are designed and built with generous service factors for long, quiet, trouble-free operation.

(2) All component parts are designed for extra heavy duty and provided at no extra cost: Extra heavy-duty output shafting, 75,000 hour service tested thrust bearings, heavy-duty inboard bearing supports, spiral-bevel gears of hardened steel and over-sized anti-friction bearings for rigid shaft support are all designed specifically to provide highest level of efficiency and economy. Dollar for dollar, you get more with Philadelphia Mixers.

(3) Philadelphia Mixers are easier to install and less expensive to service: Exclusive low headroom design permits maximum bearing span with minimum headroom. For closed tank agitation, the new Philadelphia-Garlock unitary mechanical seal assures long, maintenance-free service and, when necessary, is replaceable in minutes with no special lifting equipment needed.

Here's why Philadelphia Mixers can give you more mixer value per dollar!

No other manufacturer controls, within its own organization, such extensive and specialized designing, engineering, manufacturing, assembling, quality control and field servicing facilities devoted exclusively to fluid agitation production and operation. Phillie Gear manufactures all gears, couplings and reducer housings and machines all shafts, drive supports and impellers. As a result of such completely integrated "packaged" service, you can be sure that every Philadelphia Fluid Mixer will perform smoothly, efficiently, quietly and economically beyond the maximum specified limits for any given installation.

For the complete story on our standard line of mixers or special units for big jobs, send for Bulletin A-156.

philadelphia mixers

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

INDUSTRIAL GEARS & SPEED REDUCERS
LIMITORQUE VALVE CONTROLS
FLUID AGITATORS • FLEXIBLE COUPLINGS

Offices in all Principal Cities Virginia Gear & Machine Corp. • Lynchburg, Va.

DU PONT

CHEMICAL ENGINEERING NEWS

PROPERTY AND APPLICATION DATA
ON THIS VERSATILE ENGINEERING MATERIAL:

Bearing buttons of TEFLON® eliminate lubrication in valve handling corrosive fluids

Bearing buttons of TEFLON tetrafluoroethylene resin make this unplasticized polyvinyl chloride plug valve, used in piping corrosive fluids, permanently "self-lubricating". The exceptionally low coefficient of friction of TEFLON ($f = .04$) assures ease of turning, and prevents seizing and galling.

The buttons are designed as inserts in the valve spindle. In the closed position, the buttons provide a chemically inert block across the open diameter of the pipe. A seal of TEFLON is used on the valve shaft to prevent external leakage.

This valve has been operating for more than a year in concentrated HCl at room temperature. The user reports that no problems of corrosion, sticking or lubrication have occurred at any time so far.

TEFLON resists all chemicals normally encountered in industry. Exceptions to this are metallic alkali metals, under certain conditions. At elevated temperatures and pressures, halogens and certain halogenated chemicals and solvents may affect TEFLON.

Du Pont TEFLON remains tough through a wide range of temperatures. It has no water absorption. Sticky or viscous materials do not adhere to its waxy surface. TEFLON is specified for electrical uses because of its high dielectric strength and extremely low power factor. The combination of these properties gives TEFLON unique advantages in a broad range of applications.

It will pay you to investigate the many possible uses for Du Pont TEFLON. For data on this outstanding engineering material, available to you without cost or obligation, clip and mail the coupon below.

Vital components of Du Pont TEFLON (shown in red) are utilized in this polyvinyl chloride plug valve (patent pending) manufactured by Tube Turns Plastics, Inc., Louisville, Kentucky. Shown above is an exploded view of the valve based on a transparent mock-up made of Du Pont LUCITE® acrylic resin.

TEFLON® is a registered trademark

TEFLON is the registered trademark for Du Pont tetrafluoroethylene resin, and should not be used as an adjective to describe any other product or any component part; nor may this registered trademark be used in whole, or in part, as a trade name for any product.

NEED MORE INFORMATION?

For basic data on the properties and applications of Du Pont TEFLON, mail the coupon.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 2511, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on Du Pont TEFLON.

I am interested in evaluating this material for

_____

_____

Name _____

Firm Name _____

Position _____

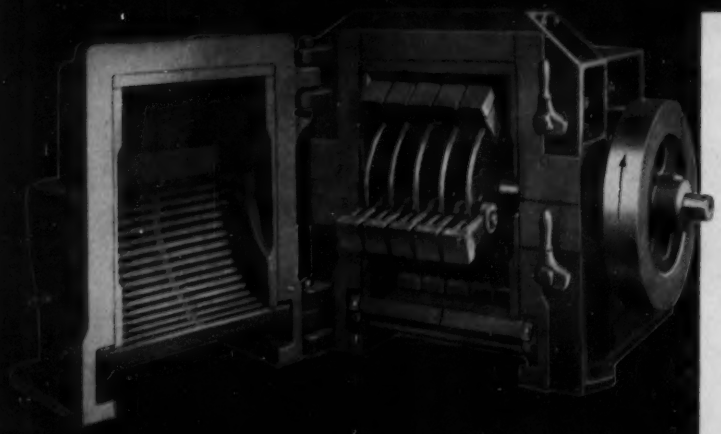
Type of Business _____

Street Address _____

City _____ State _____

"Two Minutes Daily Solved Our Tough Grinding Problem"

Says W. Carleton Merrill, *Manager*, Protein Division, Jas. F. Morse Co., Boston, Mass.



Open for Inspection

Sturtevant Swing-Sledge Mills, illustrated, crush moderately hard materials at rates up to 70 tph. Hinged-Hammer Pulverizers crush softer materials at rates up to 30 tph. Reductions on both mills up to 20 mesh. Request Sturtevant Bulletin No. 084.

Engineered to Save Downtime, Keep Production on Schedule

One man can swing open a Sturtevant Swing-Sledge Mill or Hinged-Hammer Pulverizer in less than one minute — for inspection, clean-out or maintenance — thanks to Sturtevant's unique "Open-Door" design.

Costly downtime is cut to a minimum, production kept on schedule — **even when the unexpected happens.** Little wonder that users say: "Because of their rugged construction and "One Man, One Minute" accessibility, Sturtevant machines give us **lower** operating costs over **more** years."

STURTEVANT "OPEN-DOOR" DESIGN MAKES MAINTENANCE A CINCH, INSURES OPERATING EFFICIENCY

"We wanted 100 per cent discharge area from our grates," Merrill of the Morse Co. reports. "But cake tankage — broken bone pieces and trimmings of meat and fat — can clog up any grate if all the grease isn't pressed out. In two minutes at the end of the day we can open our Sturtevant Swing-Sledge Mill for inspection, clean it if necessary, and button it up for the next day's production."

If you grind anything as unpredictable as cakes of dry rendered tankage — like the Morse Company does — or desire low-downtime for clean-outs and emergency maintenance, you'll want the "One Man, One Minute" accessibility plus rugged construction that has been engineered into Sturtevant crushing and grinding machinery.

Write today describing your problem. Please include information on materials, process and desired capacity.

Address: Sturtevant Mill Co.,
100 Clayton Street, Boston 22, Mass.

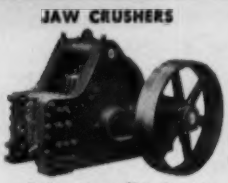
STURTEVANT

Dry Processing Equipment

The "OPEN-DOOR" to *lower* operating costs over *more* years

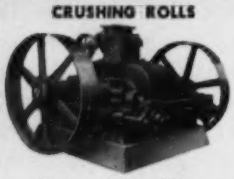
CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

JAW CRUSHERS



Reduce coarse (5 in. largest model) to fine (⅛ in.) smallest model. Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smaller sizes operate on double cam principle — crush twice per energy unit. *Request Bulletin No. 062.*

CRUSHING ROLLS



Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types—Balanced Rolls have automatic adjustment in operation; Recommended for 3 to 1 reduction. *Request Bulletin No. 065.*

ALL STURTEVANT MACHINES ARE DESIGNED TO OPERATE ADVANTAGEOUSLY IN "UNITS"

ROTARY FINE CRUSHERS

Five models reduce 3 to 8 in. soft to moderately hard materials down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. No clogging; even product flow. Smallest model has 6 x 18 in. hopper opening, largest has 10 x 30 in. *Write for Bulletin No. 063.*

RING ROLL MILLS

Reduce hard or soft 1½ in. and smaller sized material to from 6 to 200 mesh. Grind only — no screens. Capacities of 3 models range up to 18 tph, depending on model, material. Ring diameters and faces 24 x 7 in.; 45 x 8 in.; 44 x 14 in. *Request Bulletin No. 079.*

the sky's ~~the~~ *Your* limit at

If you had answered our ad four years ago, just think of the potential advancement you would have had with Chemstrand. For Chemstrand has undergone four major expansions in its four short years of operation.

If you answer our ad now, your future potential is even greater. Because Chemstrand is now just entering its fifth major expansion – and the future has just begun . . . with the sky your limit!

CHEMSTRAND

WRITE TODAY

TECHNICAL PERSONNEL MANAGER, Dept. Ch E-6
The Chemstrand Corporation, Decatur, Alabama

Gentlemen:

It is my understanding that you need for immediate employment graduate engineers in various fields, particularly chemical, mechanical, industrial, textile and instrument engineering.

I am a graduate _____ engineer.
Please send me information concerning the ground floor opportunities at Chemstrand.

NAME _____

STREET _____

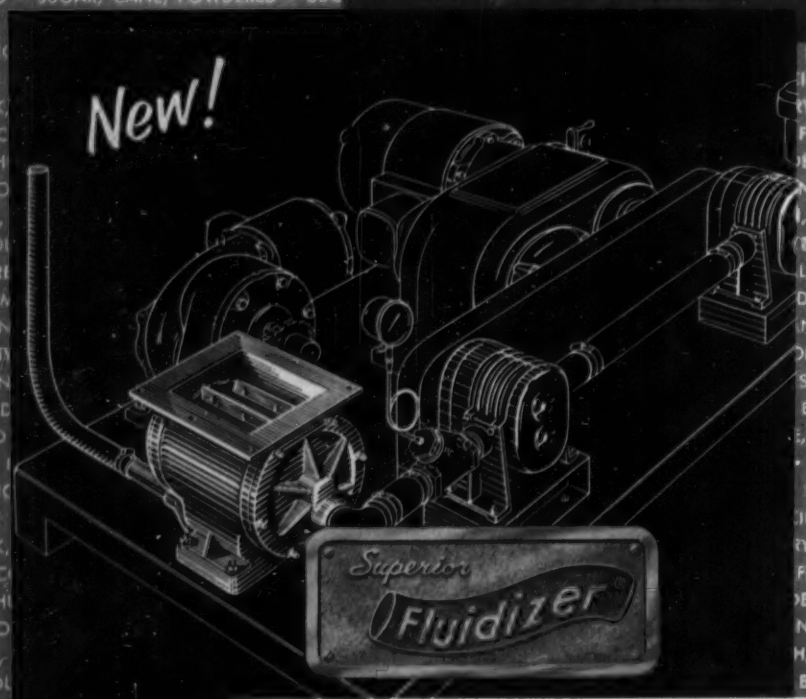
CITY _____ ZONE _____ STATE _____

THE CHEMSTRAND CORPORATION, DECATUR, ALABAMA

TOMORROW'S BIG DECISIONS WILL BE MADE by the men who act today . . .

From cake mixes to plastics . . .

most powdered materials can now be conveyed as easily as water with this unique SOLIDS PUMP!



"FLUIDIZER"® solves many industry moving and conveying problems

by: **WM. BURNET**
Chief Engineer
Process Machinery Division
Superior Separator Company

The Superior "FLUIDIZER" is creating a lot of interest in many industries. Engineers and executives from an average of 8 companies per week visit our laboratories to learn more about this new solids pump. Many bring samples of their products for testing purposes. In addition, samples arrive every day from other companies who want to know, "Will it fluidize?" Usually our answer is "Yes", our laboratory has now listed almost 100 materials which fluidize satisfactorily.

If you have a finely-divided product which must be moved, perhaps you will find the "FLUIDIZER" will perform more economically and satisfactorily than previously existing methods. Our research and testing facilities are open to you. We will be happy to test your materials and submit the findings.

Call or write today for our illustrated "FLUIDIZER" booklet. It contains the whole story of fluidization and the "FLUIDIZER's" application to industrial transporting of powdered solids.

PROCESS MACHINERY DIVISION

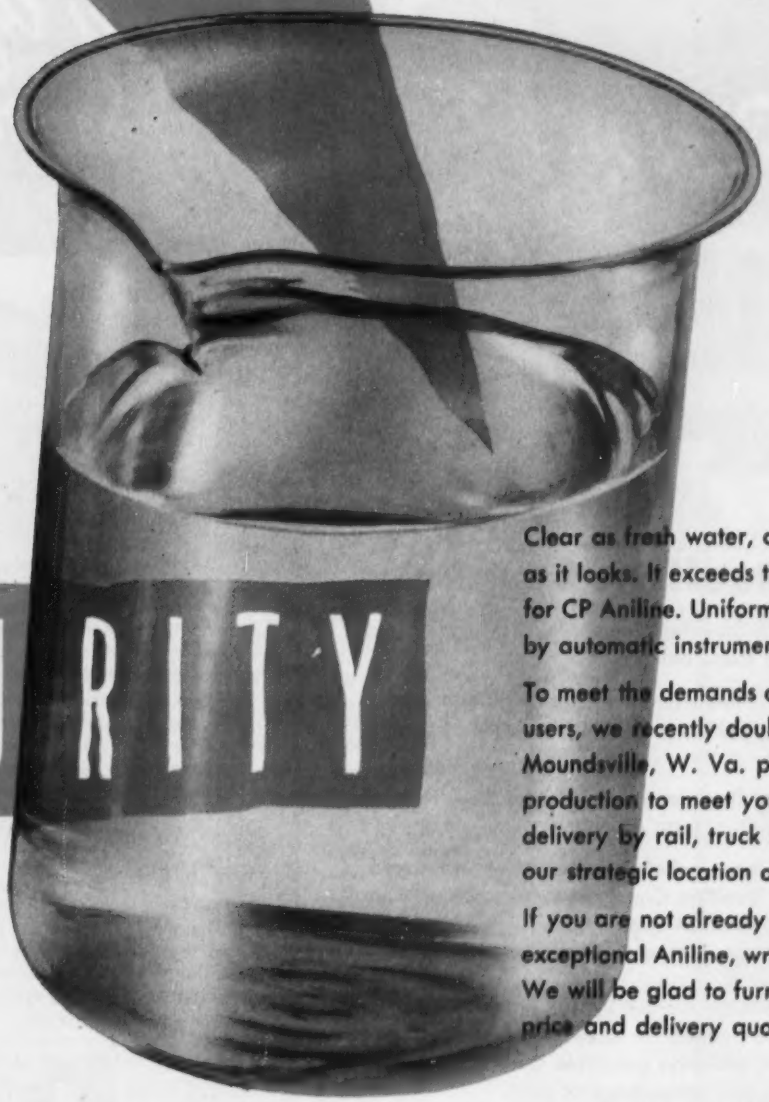
Superior
SEPARATOR COMPANY
MAIN OFFICE: HOPKINS, MINN.
HOPKINS, MINN. • PASADENA, CALIF. • CHICAGO, ILL. • NEW YORK, N.Y.

"FLUIDIZER", a registered trademark of Superior Separator Co.

HOPKINS, MINN. WEst 8-3511 | PASADENA, CALIF. RYan 1-9724 | CHICAGO, ILL. FRanklin 2-3181 | NEW YORK, N. Y. LExington 2-8878

if you use ANILINE

better look into this



PURITY

Clear as fresh water, our Aniline is as pure as it looks. It exceeds the A.C.S. specifications for CP Aniline. Uniform quality is assured by automatic instrumentation.

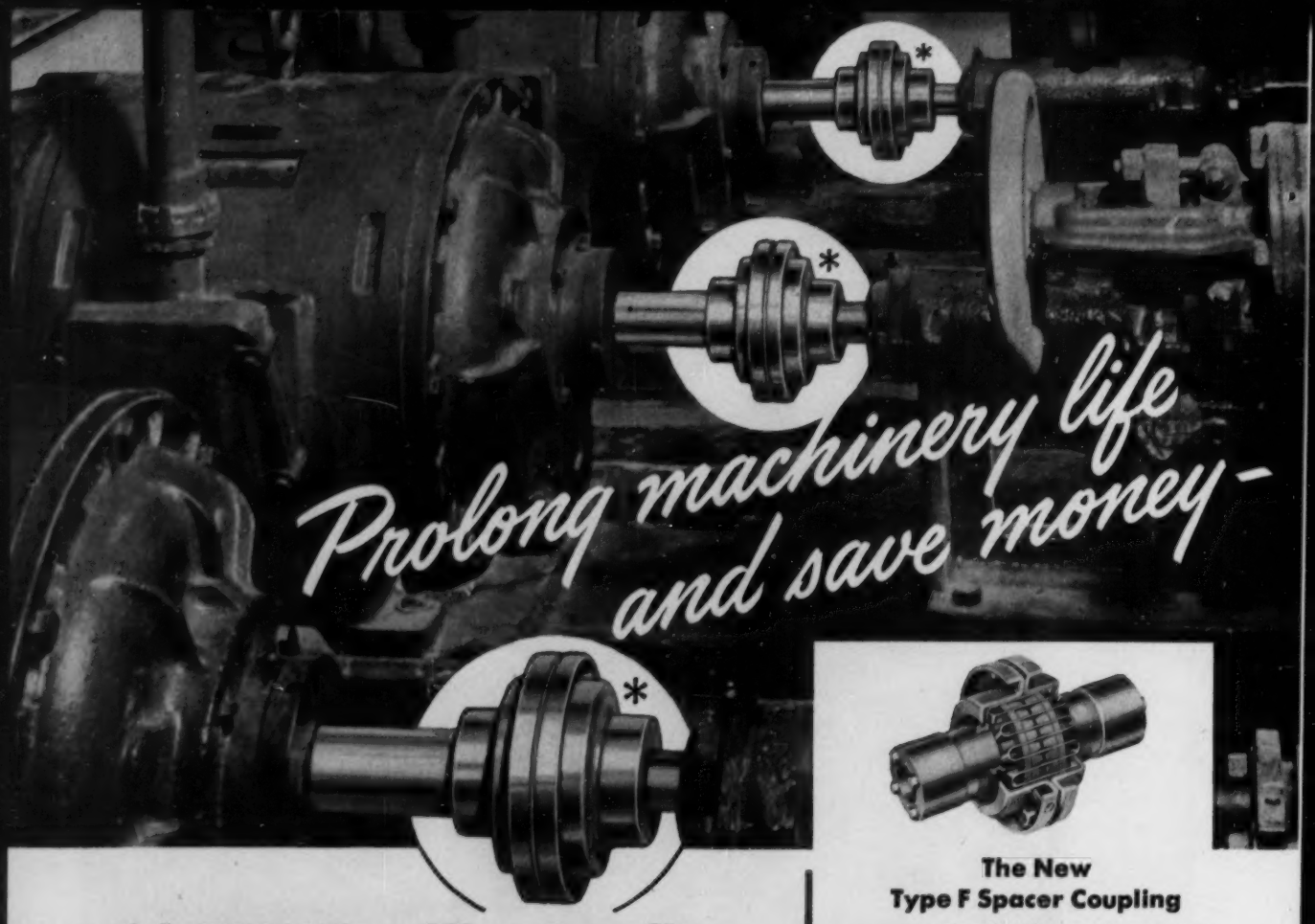
To meet the demands of quality-minded aniline users, we recently doubled the capacity of our Moundsville, W. Va. plant. Now we have ample production to meet your needs with prompt delivery by rail, truck or inland waterway from our strategic location on the Ohio River.

If you are not already acquainted with this exceptional Aniline, write for a sample today. We will be glad to furnish specifications, price and delivery quotations.

NATIONAL ANILINE DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Boston Providence Charlotte Chicago San Francisco Atlanta Portland, Ore. Greensboro Philadelphia Richmond Akron Los Angeles Columbus, Ga. New Orleans Chattanooga Toronto

Allied Chemical



Prolong machinery life and save money—

with FALK Steelflex Couplings

Ever since the first Falk Steelflex Coupling was designed and built, we have firmly held to these beliefs:

1. A coupling, to give fullest value, must do more than merely *connect* driving and driven machinery—*it must protect* the machinery and prolong its life.

2. A coupling, to be truly flexible, must overcome the effects of shock and vibration, as well as shaft misalignment.

Proof of the soundness of those beliefs is furnished by the record. More than one million Falk Steelflex Couplings have been used on every conceivable type of industrial application . . . giving trouble-free service, providing maximum protection to connected machinery.

* A single basic type—the famous Type F—fills 90% of all industrial application needs. It is versatile, efficient and economical. And—it is always available from factory, field or distributor stocks, in a wide range of sizes.

Write to Department 247 for engineering bulletin, including selection and dimension tables.

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

FALK

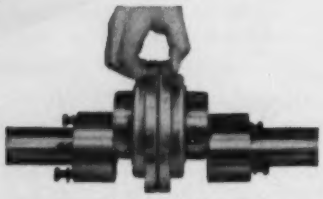
...a good name in industry

The New Type F Spacer Coupling

Here is a Steelflex coupling specially designed to permit fast, easy installation and removal in horizontal and vertical applications where it is impracticable to move the connected units—or where a space-gap (up to 12 in.) is necessary.

Like all Steelflex couplings, the Type F Spacer gives long, trouble-free service and maximum 3-way protection for connected machinery: it provides torsional resilience to reduce shock and vibration; it accommodates parallel or angular shaft misalignment; it allows free (or limited) end float.

An outstanding feature of the Steelflex Spacer is that it can be installed or removed in one piece (see photo below); no dismantling or servicing of the coupling is required. Pump assemblies can be disconnected and removed without disassembling the coupling, without exposing working parts.



The Steelflex Spacer coupling is prelubricated at the Factory and can be installed, or removed and reinstalled, without disturbing the lubricant—a highly desirable feature.

THE RIGHT STEAM TRAP FOR LIGHT CONDENSATE LOADS

YARWAY 20-A IMPULSE STEAM TRAP

There's a Yarway Impulse Trap for every trapping need

SERIES 60 AND 120

For all *normal* trap requirements, pressures to 400 and 600 psi.

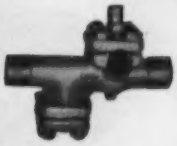
½" No. 20-A

For *light loads* on tracer lines, steam mains, small presses, etc.

SERIES 40

For *heavy loads* requiring extra high capacity steam traps.

INTEGRAL-STRAINER HIGH PRESSURE TRAP



For *high pressures, high temperatures.* (Flanged or welding connections.)

● Successful companion to the standard Series 60 YARWAY Impulse Steam Trap, the ½" No. 20-A is right and recommended for *light load* applications in:

REFINERIES, CHEMICAL AND PROCESSING PLANTS on steam tracer lines, meter boxes, steam mains, separators, small dryers, pipe coils, small unit heaters, etc.

POWER PLANTS on headers, fuel oil preheaters, compressed air lines, small steam jacketed fire pumps, etc.

HOSPITALS, SCHOOLS, HOTELS AND INSTITUTIONS on autoclaves, sterilizers, steam tables, washers, small pressure cookers, steam mains, etc.

LAUNDRIES on small presses, puff irons, sock forms, drying cabinets, starch cookers, steam mains, etc.

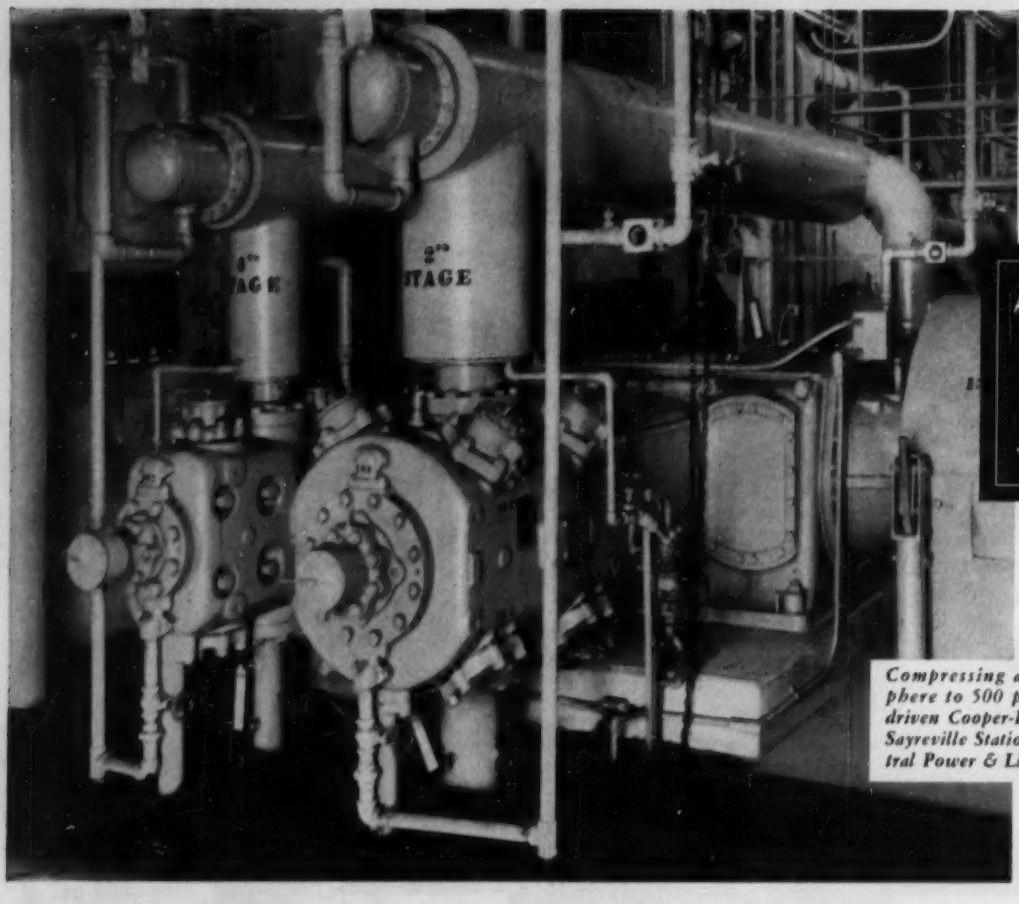
The 20-A has all the YARWAY Impulse Trap features such as small size, stainless steel body and working parts, low cost, non-freezing—and immediate availability through 270 local Industrial Distributors.

Write for Bulletin T-1739-X.

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE® STEAM TRAP

OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED



Compressing air from atmosphere to 500 psig . . . motor-driven Cooper-Bessemers in the Sayreville Station of Jersey Central Power & Light.

How Cooper-Bessemer compressors cut trouble and cost in soot blowing service

• Here's an unusual example of flexibility and reliability in soot blowing operation. Three Cooper-Bessemer FM compressors, each rated 350 hp at 500 rpm, compressing air from 0 to 500 PSIG for the Sayreville Station of Jersey Central Power & Light Company, Sayreville, N. J.

Equipped with controls for 5-step automatic operation, these Cooper-Bessemer units assure maximum safety, permit minimum attention by operating personnel. Although compact in design, these compressors retain the accessibility feature so often lacking in similar type units.

If you require a dependable supply of air . . . for many years to come . . . you'll profit from a call to Cooper-Bessemer. Check the latest advancements now being offered by one of America's *oldest* engine and compressor builders.

ENGINES: GAS • DIESEL • GAS-DIESEL COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

cooper-bessemer

MOUNT VERNON, OHIO • GROVE CITY, PENNA.

Branches in principal U.S. Cities, also: Edmonton and Calgary, Alberta • Halifax, N.S. • Caracas, Venezuela • Mexico City, Mex.

...SINCLAIR CHEMICALS ALWAYS RIDE FIRST-CLASS!

Two special fleets of tank cars are added assurance that you get what you pay for when you specify Sinclair! To guard against contamination, Sinclair ships odorless solvents and aromatics in separate tank car fleets used exclusively for this purpose. It saves trouble!

TRULY ODORLESS SOLVENTS – Sinclair's team of truly Odorless Solvents, both Light (340-405° F.) and Heavy (375-465° F.), are synthetically produced from carefully selected hydrocarbons to insure the uniformity, stability and superior quality required by manufacturers of odorless paints. Available in full, or split tank car quantities.

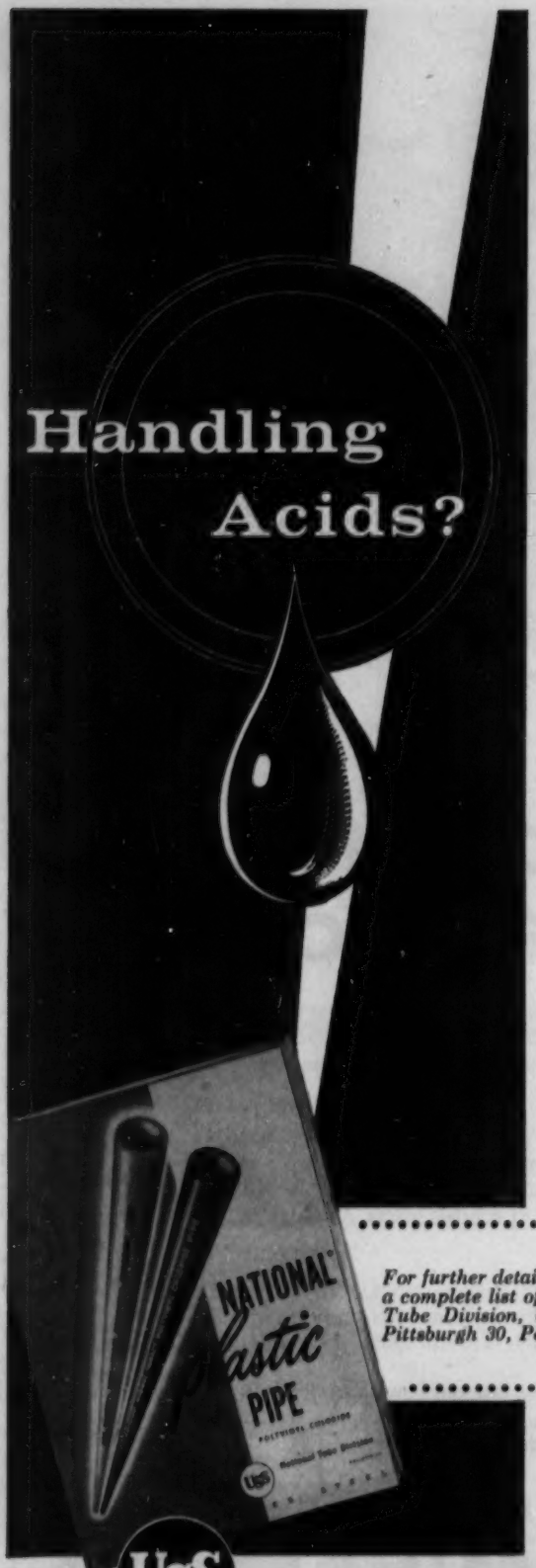
HIGH PURITY AROMATICS – Toluol (1° nitration grade), Xylol (5°), and Paraxylene (98%) are being produced by modern Udex extraction facilities at Sinclair's Marcus Hook, Pa., refinery. Available in full, or split tank car quantities.

When your manufacturing processes call for fast and reliable service, and top quality in petroleum-derived chemicals, Sinclair Chemicals, Inc. is ready to serve you. For complete information call or write to:

SINCLAIR CHEMICALS, INC.

(Affiliate of Sinclair Refining Company)

600 Fifth Avenue, New York 20, N. Y. • Phone: Circle 6-3600
155 North Wacker Drive, Chicago 6, Illinois • Phone: Financial 6-5900



WANT a pipe that can take it? One that will end your corrosion worries? Want a pipe that handles acids, alkalis, alcohols, salts and hundreds of other chemicals with the same impunity with which it transports water?

Then you want USS NATIONAL* PVC Plastic Pipe.

This extruded Polyvinyl Chloride Pipe is available in sizes ½" to 6" diameter—in Schedules 40, 80 and 120. You can get NATIONAL PVC Plastic Pipe in two types:

NORMAL IMPACT—designed for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

HIGH IMPACT—designed for installations requiring excellent chemical resistance and a high degree of toughness, even at low temperatures.

In addition to its excellent chemical resistance, NATIONAL PVC Plastic Pipe offers:

Rigidity—permits use in overhead piping installations with pipe supports. Schedules 80 and 120 pipe may be threaded with steel threading dies.

Lightness—twenty feet of 2-inch, Schedule 40 pipe weighs less than 13 pounds. Easy to install in cramped space and hard-to-reach places.

Weather Resistance—resists deterioration due to aging when exposed to direct sunlight. Also resists fungi, bacterial action and soils.

Simple Installation—fittings quickly and easily attached by either solvent cementing, threading, heat welding, or adhesives.

Smooth Internal Surface—results in low flow resistance, minimizes build-up of deposits.

**Trademark*

For further details on USS National Polyvinyl Chloride Plastic Pipe, including a complete list of chemical resistances, send for Bulletin 24. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

NATIONAL *plastic* PIPE

UNITED STATES STEEL

Jenkins designed for trouble-free performance... a

STAINLESS STEEL "Y"

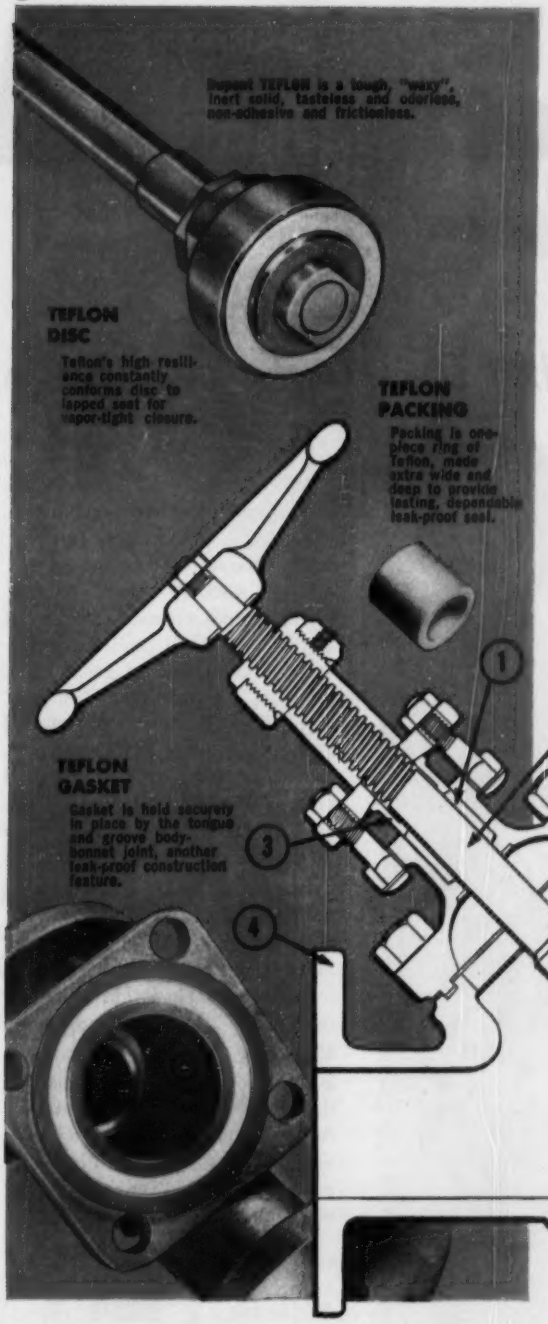
to lower costs in a wider range of

CORROSIVE SERVICES

For food and chemcial plants, and similar services, Jenkins Fig. 1335 "Y" Globe offers many advanced features that will lower operating costs and keep your processing lines trouble-free. The disc, packing, and gasket are tough, resilient Teflon. Tasteless and odorless, it eliminates problems of contamination.

The "Y" pattern permits full flow, nearly equal to that of a gate valve, and also provides the vapor-tight closure and the ease of disc renewal of a globe valve.

Fig. 1335 offers extra value by any test . . . *initial cost, operating efficiency, low maintenance.* You can convert this extra value into *extra savings* on your toughest corrosive services. Call your Jenkins Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.


Dupont TEFLON is a tough, "waxy", inert solid, tasteless and odorless, non-adhesive and frictionless.
TEFLON DISC
Teflon's high resilience constantly conforms disc to lapped seat for vapor-tight closure.
TEFLON PACKING
Packing is one-piece ring of Teflon, made extra wide and deep to provide lasting, dependable leak-proof seal.
TEFLON GASKET
Gasket is held securely in place by the tongue and groove body-bonnet joint, another leak-proof construction feature.
1
2
3
4

FULL, FREE FLOW
through Fig. 1335 is nearly equal to flow through a gate valve.

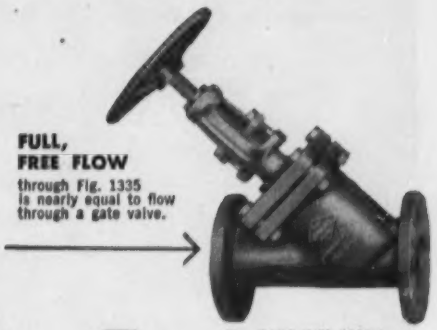


Fig. 1335 "Y" GLOBE
150 lbs. O.W.G. at 500°F
230 lbs. O.W.G. at 100°F
Sizes 1" to 4"

(1) **Packing Box**—Exceptionally deep and wide to hold optimum size packing.

(2) **Spindle**—Polished shank, long-operating threads, bevel shoulder for backseating.

(3) **Gland**—Two-piece for equalized pressure, tight seal.

(4) **Flanges**—Conform to M.S.S. Standard Practice S.P.42 Specifications.

JENKINS STAINLESS STEEL VALVE BOOKLET illustrates and describes wide range of Jenkins Globe, Gate, Check, and Y Valves, includes selection data, survey forms. Ask for Form 200-A.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK

Sand and Ground Glass Solution

60 feet straight up

with dependable De Laval CPO Pumps

These De Laval CPO Pumps are at work 24 hours a day, 7 days a week

Here's proof of the dependability of De Laval CPO Pumps. In one large automotive company, glass grinders work 24 hours a day, 7 days a week virtually every week in the year. They cannot grind without the sand and ground glass polishing compound which must be pumped 60 feet straight up and over to a grinding room. Says the supervisor, "We have encountered no trouble at all, nor has there been any downtime for the grinders due to the pumping operation."

These pumps have cast iron casings with De Laval KK-20 (20-28 stainless) internals. This superior metal is also being used successfully on other problem fluids which require KK-20 for the casing as well.

Three bearing pedestals accommodate nine wet end sizes of the De Laval CPO, and changes in size or metallurgy can be made *after* installation with off-the-shelf parts. Either conventional or mechanical seals are available.

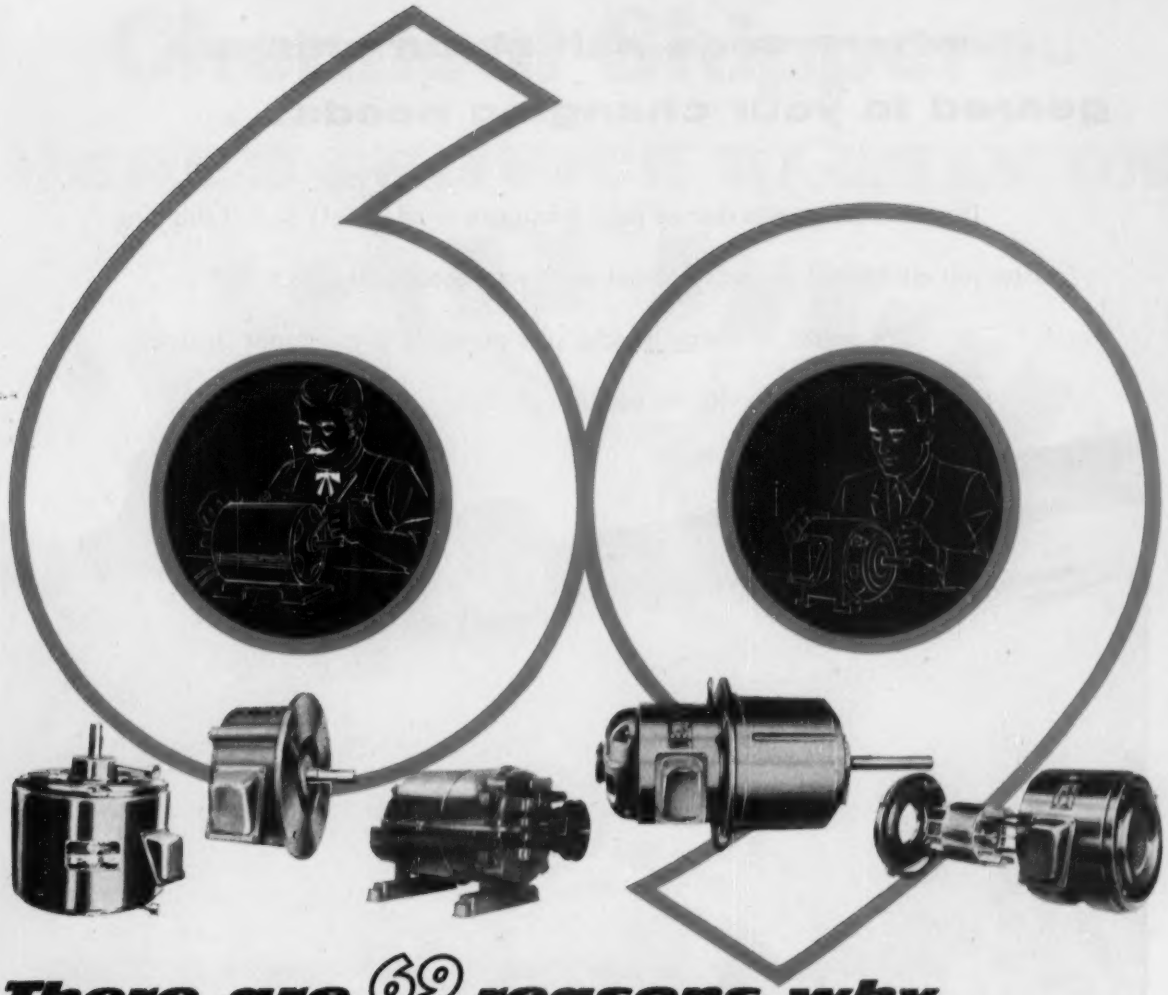
Write for Bulletin 1125-B

DE LAVAL *CPO Process Pumps*

DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

DL 348



There are 69 reasons why

—Diehl can build better motors. For 69 years, successive generations of Diehl motor specialists have applied their accumulated know-how to solving the power problems of widely divergent types of industries. In the smallest shops or the largest plants—all over America—Diehl men study the problem along with the customer. Name your motor requirements—no matter how "different," it's more than likely that an almost-similar situation has been recently brought to a successful conclusion with Diehl action. Here's where Diehl know-how helps you. The right answer and the right motor—*at the most reasonable cost*—can be yours, fast! Designed and built for your job. Get all the power and get it right—from Diehl.

You invest in Performance

when you design with DIEHL.

Diehl

DIEHL MANUFACTURING COMPANY
Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, Somerville, N. J.

Please send me Bulletin No. 3526 CE

Name_____

Company_____

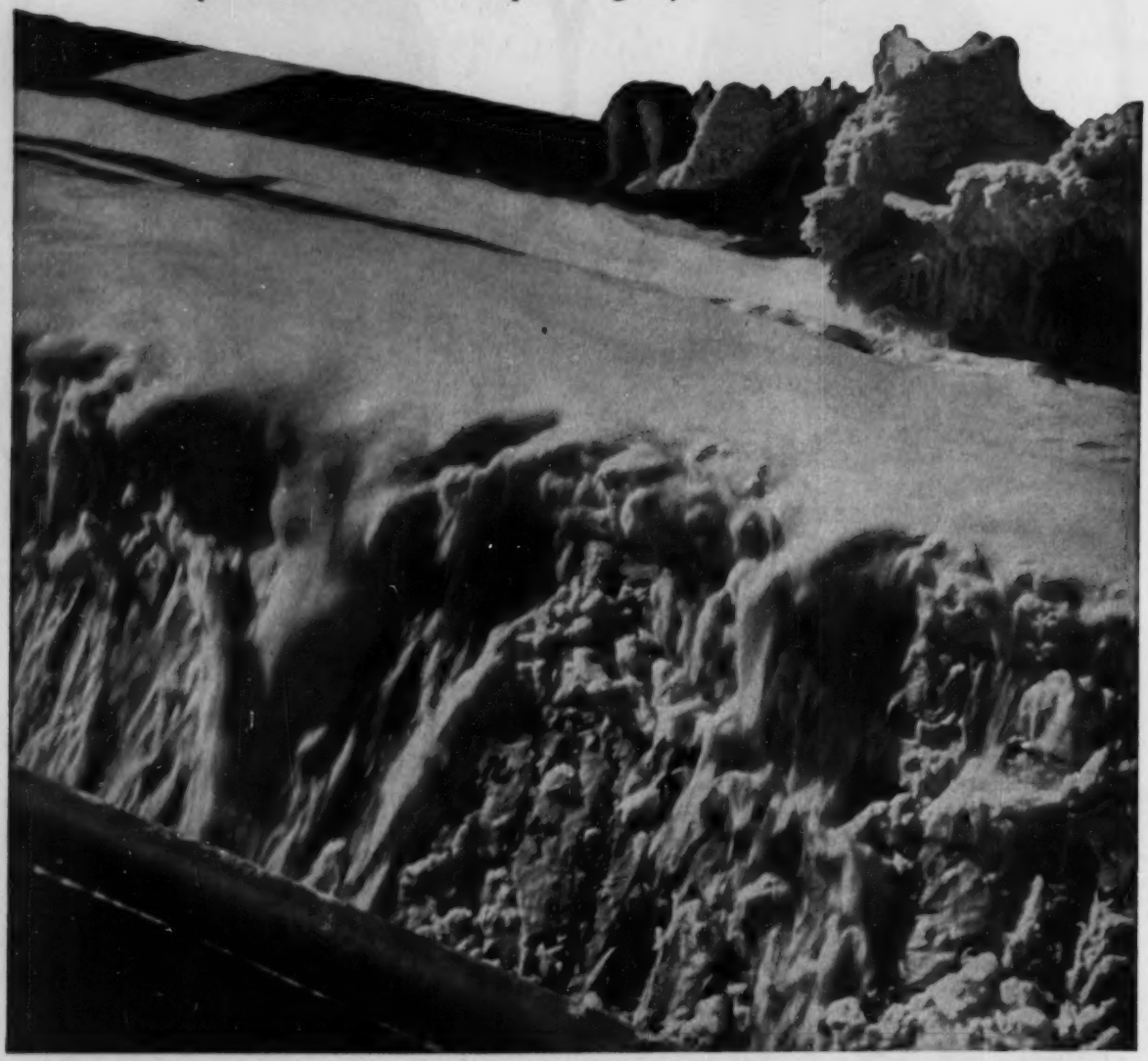
Street_____

City_____ State_____

INTEGRAL AND FRACTIONAL HORSEPOWER MOTORS ARE AVAILABLE IN A WIDE RANGE OF TYPES AND SIZES

...where soda ash shipments are geared to your changing needs...

If your requirements change (and it happens to all of us!) so that shipping dates you established yesterday do not serve your needs today, West End is geared to rearrange schedules promptly to meet your current requirements... a service we perform gladly.



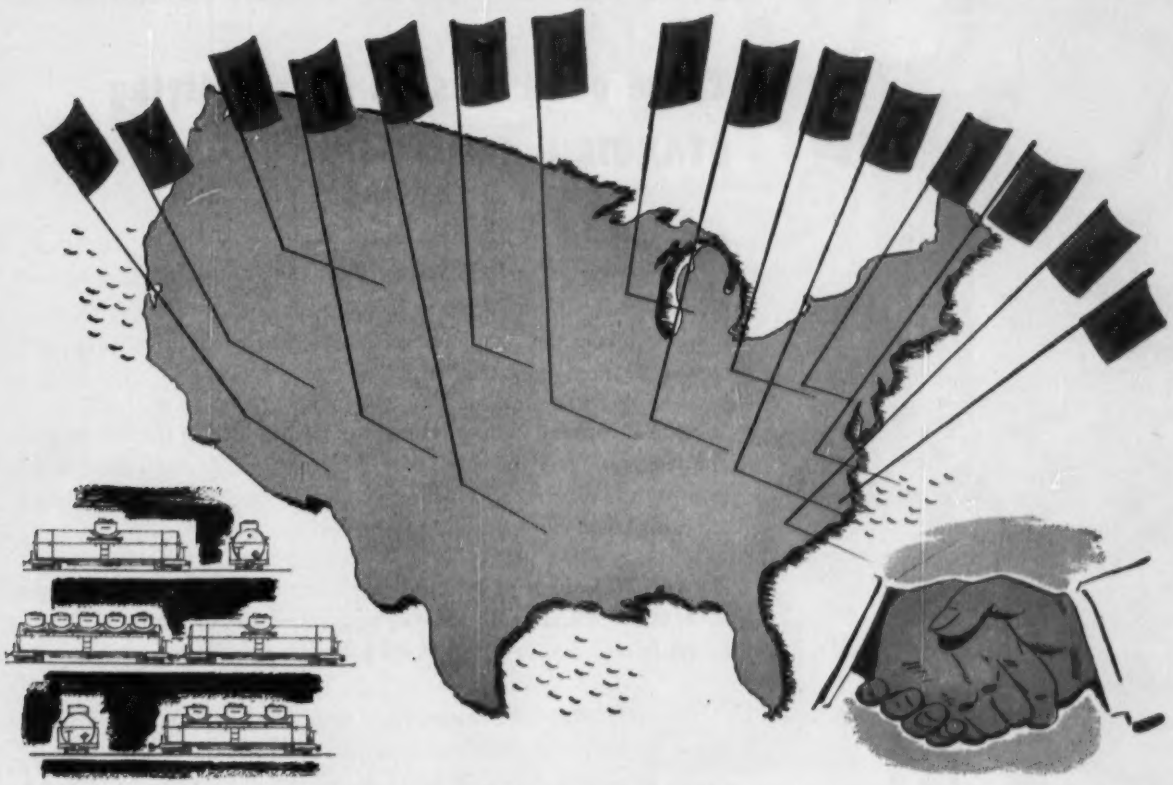
WEST END **West End Chemical Company**

SODA ASH • BORAX • SODIUM SULFATE • SALT CAKE • HYDRATED LIME

EXECUTIVE OFFICES, 1956 WEBSTER, OAKLAND 12, CALIFORNIA • PLANT, WESTEND, CALIFORNIA

Chemical Shippers-

HERE'S SERVICE TO RELY ON



1. A big fleet of single and multiple compartment chemical cars that have been specially adapted and lined for customer requirements. (Special chemical cars will also be built for individual needs.)

2. A nationwide organization of convenient offices and personnel applying shipping knowledge gained in nearly half a century of operation.

3. A very special understanding of chemical shipping problems and a background of close co-operation with the chemical industry.

It's a combination that delivers your bulk chemical shipments safe, clean, fast and sure wherever there's a railroad track—and at low cost! Let us know your requirements. You can depend on North American helpfulness and service.

FOR [redacted] PRODUCTS REQUIRING [redacted] CARE

NORTH AMERICAN CAR CORPORATION

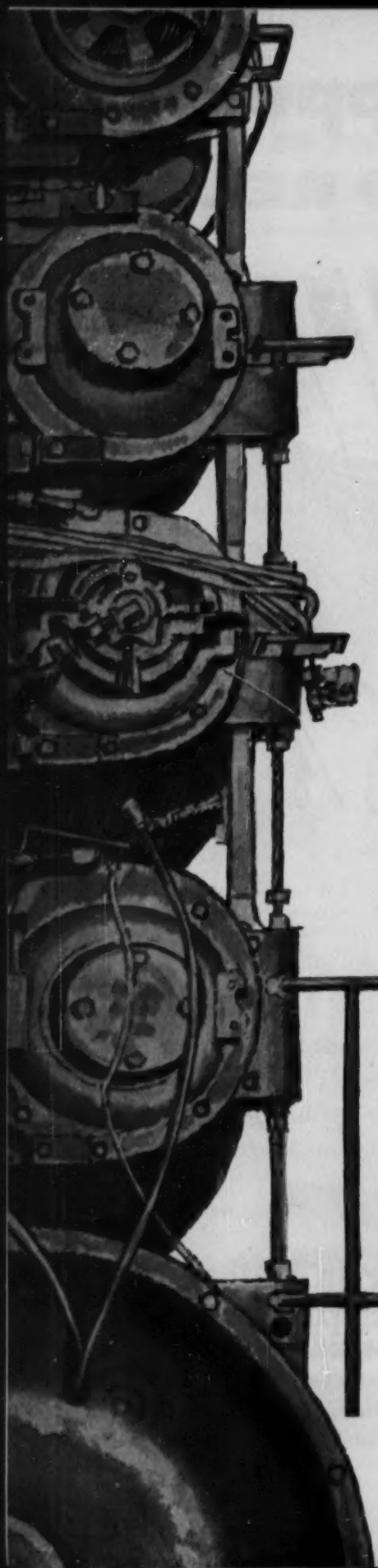
NORTH WESTERN REFRIGERATOR LINE COMPANY

MATHERS HUMANE STOCK TRANSPORTATION COMPANY

A NATIONWIDE ORGANIZATION WITH BRANCH OFFICES IN IMPORTANT MARKET CENTERS

231 South La Salle Street, Chicago 4, Illinois

Dallas • Fond du Lac • St. Paul • St. Louis • Tulsa • San Francisco • New York



To the mill executive who decides on lubricants—

Three good reasons for specifying STANOIL Industrial Oil

1 The increased demand for paper products results in machinery being operated at speeds higher than rated capacity. Continuous production has placed greater burdens on lubricating oils. Without the best lubrication, equipment failures may occur. Best idea is to specify STANOIL Industrial Oil.

2 Cost of repairs and replacement of parts added to the loss of production, run many times the cost of lubrication. A small investment in STANOIL Industrial Oil is the best possible protection against bearing failures, repair costs and production loss.

3 STANOIL Industrial Oil can be used in a multitude of applications. Inventories of lubricants can thus be reduced and the danger of lubrication failure due to misapplication can be cut or even eliminated.

Get more facts about STANOIL from your nearby Standard Oil lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

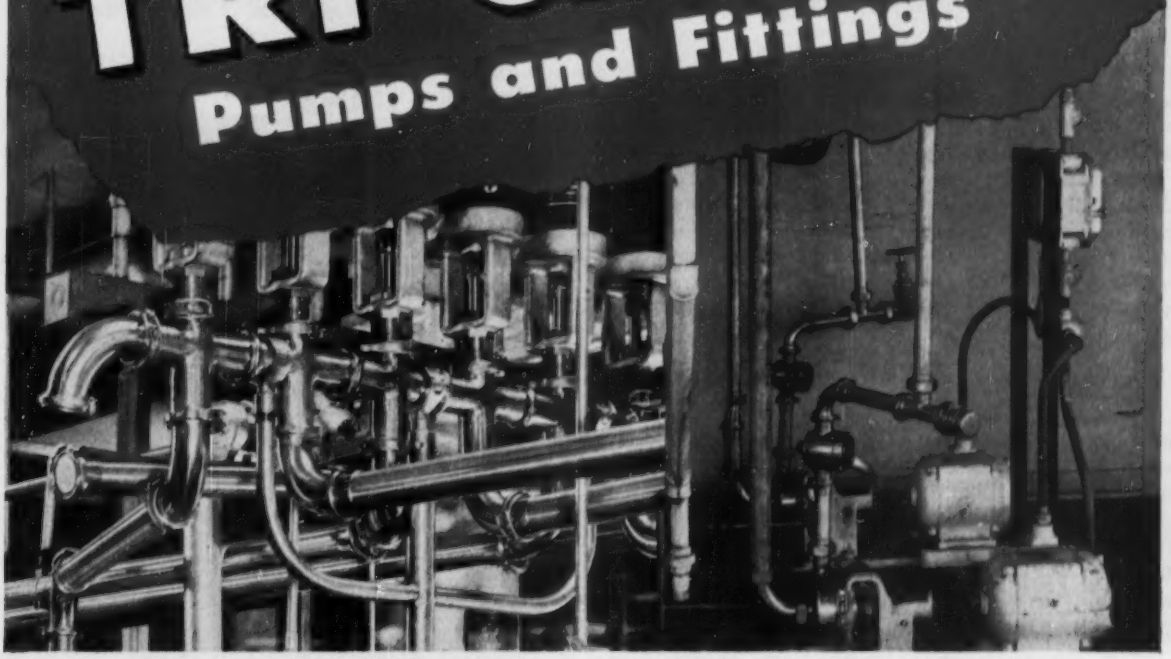
Quick Facts About STANOIL Industrial Oil

- **Stability**—STANOIL's antioxidant gives oil resistance to chemical change, minimizes deposits.
- **Rust Prevention**—Inhibitor in STANOIL "plates out" on metal surfaces, prevents corrosion.
- **Cold Starts**—STANOIL has low pour point. Flows freely from cold start. No need for costly warm ups.
- **Resists Effects of Temperature Change**—STANOIL has high viscosity index, is resistant to temperature change. Lubricates in both high and low temperature service.
- **Has Excellent Demulsibility**—STANOIL is refined to eliminate emulsion problems, contains additive to minimize foaming.

STANDARD OIL COMPANY
(Indiana)

STANDARD

Solve Corrosion Problems and Protect Product Quality . . . with TRI-CLOVER Pumps and Fittings



Battery of electrically-operated Tri-Clover compression valves with Tri-Clamp connections in a liquid conveying line.

A large midwestern processing plant employs these Tri-Clover centrifugal pumps and Tri-Clamp valves and fittings for handling corrosive liquids.

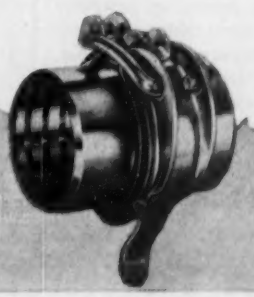
Reduce Corrosion!
Protect Product Quality!

These are vital considerations when selecting pumps and fittings for chemical process service. Tri-Clover Division's constant research has developed exclusive design features that combine a high degree of corrosion-resistance with ease of assembly and disassembly . . . thus facilitating cleaning as well as allowing fast and economical changes in piping arrangements.

For pumping applications, Tri-Clover has a full line of centrifugal pumps designed to handle any product that will flow to them. A wide choice of seals are available, including inert carbon rotary seals for sanitary applications, packing gland seals, water cooled seals and seals for latex handling.

Tri-Clover stainless steel fittings of the sanitary type, with polished inside and outside surfaces, offer protection against corrosion and product contamination. They are available in threaded types or in the new Tri-Clamp design—no welding is required.

Let our engineering staff help you solve your liquid conveying problems. Write for descriptive literature.



The sanitary type Tri-Clamp union with snap-action spring clamp and toggle locking device is shown at the right. Available also with bolt type locking device in Schedule 5 pipe and Tube O.D. sizes in stainless with white pickle finish. Write for information.

LADISH CO.
Tri-Clover Division
Kenosha Wisconsin

See your nearest Tri-Clover Distributor.

TRI-CLOVER

Export Dept.
8 S. Michigan Ave.
Chicago, U.S.A.
Cable TRICLO

I-324

Simplest pneumatic controller to use and maintain

Bristol gives you improved stability of control action –but keeps basic simplicity of Series 500 Controllers

Bristol Series 500 Pneumatic Controllers are the easiest controllers on the market to use and maintain–still the most dependable and trouble-free.

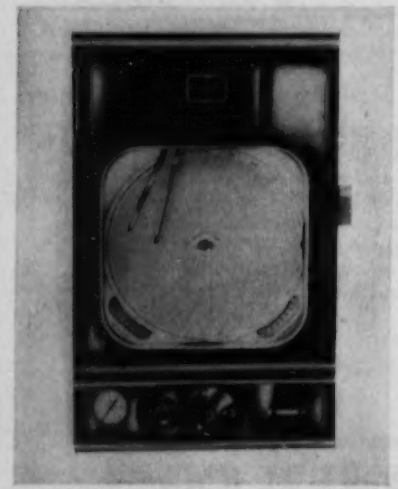
The reason? The basic simplicity of the operating mechanism. *That* hasn't changed in the years since we introduced this long-time favorite among instrument men. Reason No. 2: they are equipped with famous Bristol measuring elements.

Easy calibration

It's this foolproof simplicity of the control system that makes calibration so easy on Series 500 controllers. *Only one* service adjustment is required and provided to exactly calibrate the control system. The control system can be completely disassembled and after reassembly (even with replacement of parts) can be restored to precise calibration with this *one* adjustment.

No special tools are required. A ¼-inch wrench is all that's needed.

The 500's completely interchangeable parts, accurately designed and manufactured to extremely close tolerances, make possible this built-in calibration.



BRISTOL'S® SERIES 500 CONTROLLER, shown here with four-position transfer station. Internal station also available.

And check these features:

Improved control stability—advanced automatic control techniques have been applied by Bristol engineers to improve stability of control action in the new Series 500W Controllers.

Wide-band models offer choice of ½ to 400% proportional band with simple band shift.

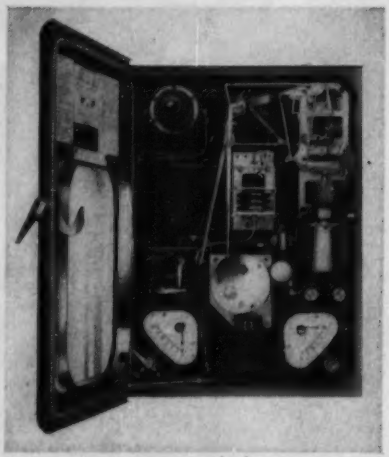
True zero derivative setting—exclusive with Bristol.

Reset action stops in reset models—again a Bristol exclusive—prevent loss of control due to prolonged deviation from set point.

Four-position internal transfer station with automatic, manual, test, and service positions, plus pressure-matching button and manual pressure regulator, for maximum convenience in process control.

Complete data available

Write today for engineering data on Bristol's Series 500 controllers for your critical control problems. They're available for *automatic control of temperature, pressure, vacuum, draft, absolute pressure, liquid level, humidity, pH value, electrical measurements, and mechanical motion.* The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.



FOUR-POSITION INTERNAL TRANSFER STATION shown here in interior view of Series 500 Controller. Permits remote manual control, testing and servicing without disconnecting instrument.

YOU CAN GET THESE CONTROL MODES:

1. **Fixed narrow band** (on-off)
2. **Proportional band**—½ to 100% and ½ to 30%.
3. **Reset with wide band**—rates 0.1 to 10 or 1 to 300 repeats per minute. Proportional band ½ to 400%.
4. **Derivative (rate)**—½ to 100% proportional band. Derivative time 0.2 to 20 min., plus zero derivative setting.
5. **Reset plus derivative**—proportional band and reset rate as in "reset" above. Derivative time as in "derivative" above.

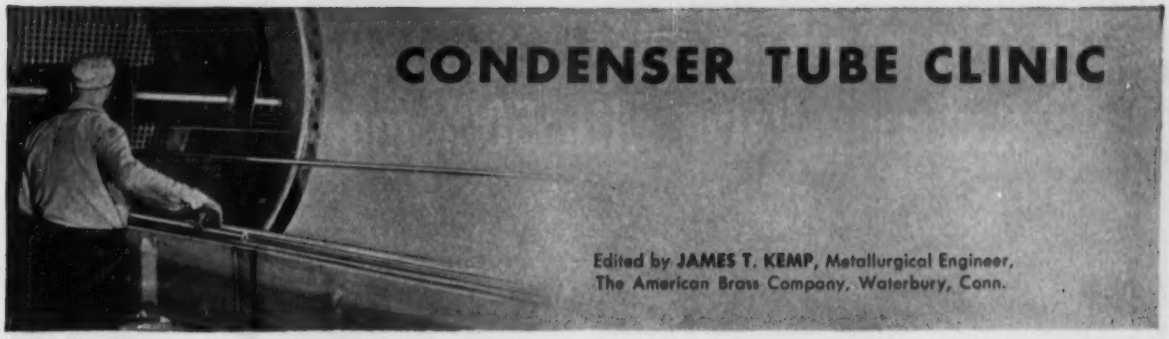
YOU CAN HANDLE THESE CONTROL PROBLEMS:

1. Cascaded control 2. Selective control 3. Ratio control 4. Time-program control 5. Pneumatic transmission.

6.55

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

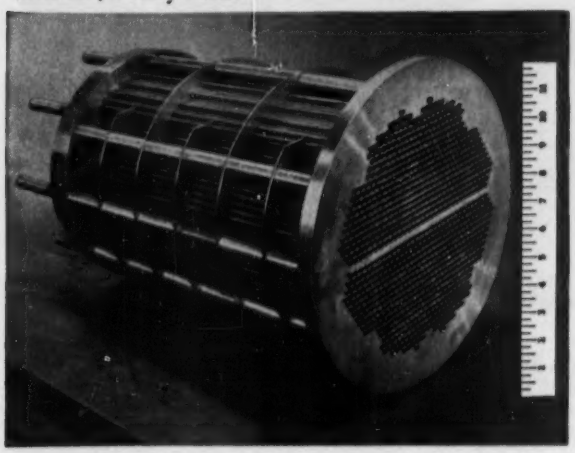


CONDENSER TUBE CLINIC

Edited by JAMES T. KEMP, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

20" x ¼" O.D. Tubes need Same Care and Attention as large 60-foot Condenser Tubes

The Tube Bundle shown below is only 12 inches in diameter and 20 inches long. It is the heart of the compact, efficient lubricating-oil cooler built by the Andale Company, Lansdale, Pennsylvania.



In each bundle there are 946 tubes, each 20 inches long, ¼-inch O.D. by 0.035-inch wall thickness. They are of ANACONDA Phosphorized Arsenical Copper-108 for fresh-water duty or of ANACONDA Ambraloy-927 (Aluminum Brass), ANACONDA Cupro Nickel, 10%-755, or ANACONDA Cupro Nickel, 30%-702 for salt water. They are expanded in high-strength rolled ANACONDA Ambraloy-917 (Aluminum Bronze) tube sheets.

When the tubes are brass, the complete tube bundle is stress-relieved as an assembly at a temperature of 550 F.

These small tubes—cut to short lengths, with ends burnished, highly finished surfaces inside and out, close dimensional tolerances—are typical of The American Brass Company's product, although at the lower end of the schedule of sizes.

The Same Precision in control of alloy, dimensions, anneal or temper governs the manufacture of all ANACONDA Heat Exchanger Tubes in the plants of The American Brass Company—from these little oil-cooler tubes on up to the largest sizes used in sugar evaporators, and the long lengths needed in high-pressure feed-water heaters in steam power stations.

Full Range. ANACONDA Heat Exchanger and Condenser Tubes are made for all sizes and kinds of shell-and-tube, submerged, spray-tower, and finned-atmospheric heat transfer equipment—for operation at elevated temperatures in conformance with ASME standards for allowable stresses.

Technical Assistance. Our Technical Department is regularly helping manufacturers, electric companies, marine operators, petroleum and chemical companies to select the correct tube alloy for many types of condensers and heat exchangers. This service is available to you without obligation. Write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

ANACONDA®

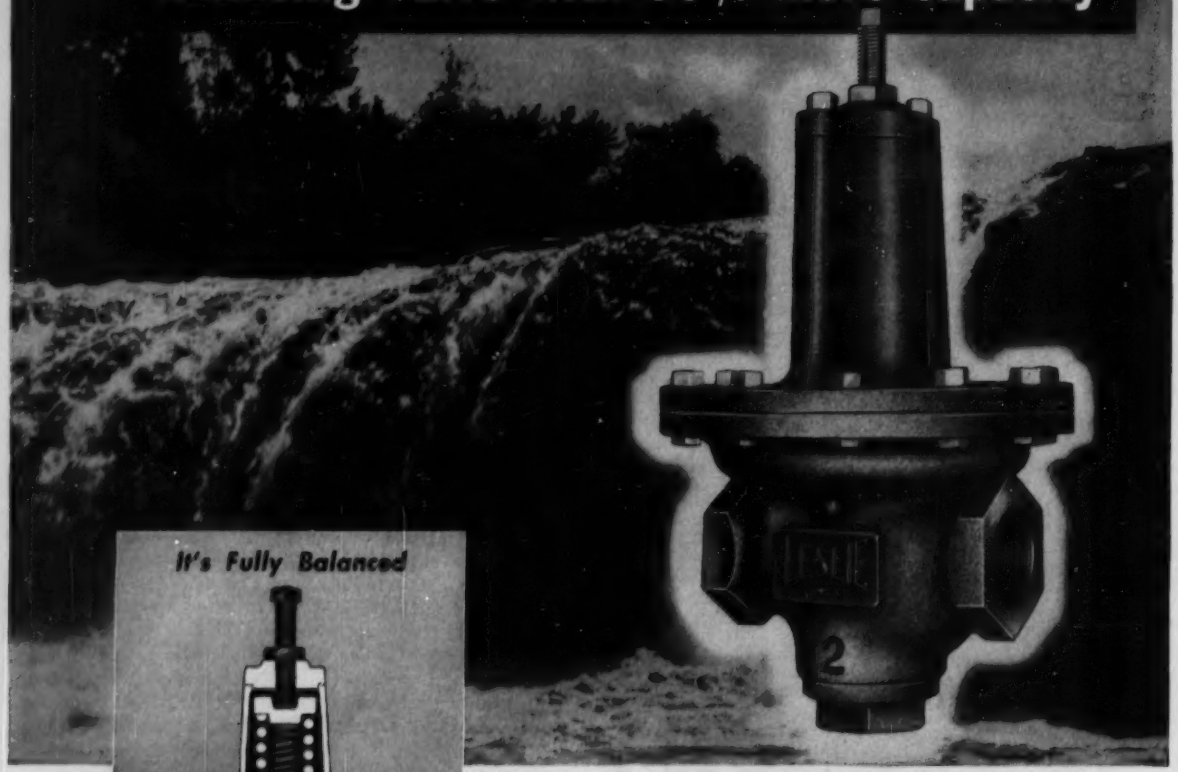
Tubes and Plates
for Condensers and Heat Exchangers

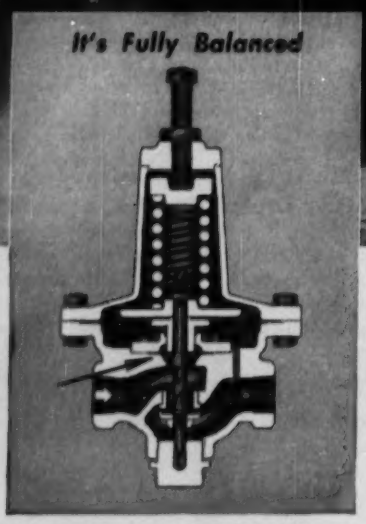
PHYSICAL PROPERTIES OF ANACONDA CONDENSER TUBES*

ALLOY	Tensile Strength, psi	Yield Strength at .5% Elongation Under Load, psi	Elongation in 2", %	Rockwell Hardness, B Scale	Density, Lb. per Cu. In.	Thermal Conductivity, B.T.U./Sq. Ft./ In./Hr./°F. at 68° F.	Average Coefficient of Linear Thermal Expansion per °F. (77-572 F.)
Arsenical Admiralty-439	52,000	22,000	60	6-45	0.308	768	.0000112
Ambraloy-927	60,000	27,000	55	35-65	0.301	696	.0000108
Ambraloy-901	60,000	30,000	60	30-60	0.295	552	.0000099
Cupro Nickel, 30%-702	55,000	22,000	50	30-60	0.323	204	.0000090
Cupro-Nickel, 10%-755							
Light Annealed	44,000	22,000	46	25	0.323	314	.0000093
Light Drawn	60,000	57,000	15	68			
Red Brass-24	42,000	15,000	50	0-30	0.316	1104	.0000104
Ambronze-421	46,000	20,000	55	0-30	0.316	830	.0000102
Phosphorized Arsenical Copper-108							
Light Drawn	40,000	35,000	20	20-50	0.323	1344	.0000098
Hard Drawn	54,000	50,000	8	50-70			
Phosphorized Copper-103							
Light Drawn	40,000	35,000	20	20-50	0.323	2364	.0000098
Hard Drawn	54,000	50,000	8	50-70			

*Note: The above values are approximate and should not be used for specification purposes. *Light annealed except as noted.*

Here is the new LESLIE "HI-FLO" Water Reducing Valve with 50% more capacity





Unique construction of "Hi-Flo" Reducing Valve. Note the small lower diaphragm that provides fully balanced, floating action.

HERE IS THE ALL NEW Leslie Reducing Valve with *capacity-regulation* features that have never been offered before. Here is a regulator with 50 - 100% greater capacity by actual test.*

Here's the unbeatable combination of design features:

"HI-FLO" — Large bowl construction; long stroke diaphragm gives full flow of water and other non-corrosive liquids.

FULLY BALANCED — The main valve, fully balanced by lower diaphragm, virtually floats to provide smooth, friction-free, throttling action.

DROP-TIGHT SHUTOFF — Resilient seating disc provides tight closure under all conditions.

TROUBLE-FREE DESIGN — Chatter and hammer eliminated; no piston cups or seals to clog or change. Corrosion resistant trim with renewable interchangeable fit.

Ask your Leslie Engineer to show you how the exclusive Leslie "Hi-Flo" valve can be used to your advantage in water reducing stations, fuel oil pressure control, process lines, etc. He's in your classified directory under "Valves" or "Regulators".

Write today for Bulletin 553 for graphic performance comparison and complete capacity data.

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 279 GRANT AVENUE, LYNDHURST, NEW JERSEY

139

CONTROLLED QUALITY MEANS QUALITY CONTROLS

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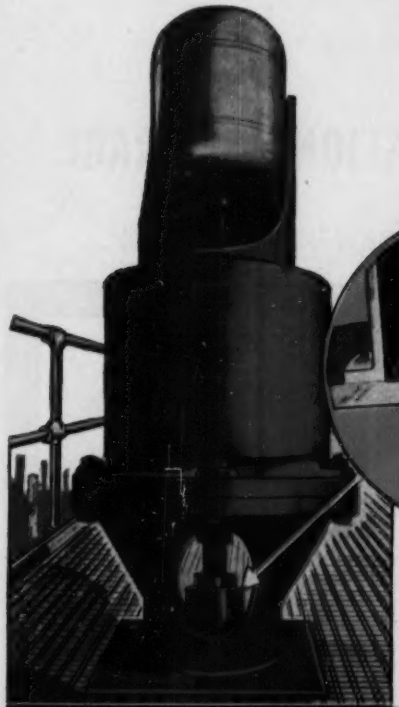
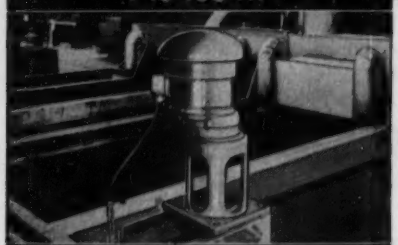


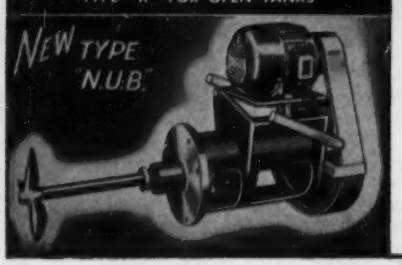
REDUCE YOUR LIQUID PROCESSING COSTS

with "INTERNATIONAL" Equipment, of course!

Type "FR" INTERNATIONAL
Slow Speed Turbine Type Mixer
also available in right angle types
1 to 100 HP



TYPE "K" FOR OPEN TANKS



There's an INTERNATIONAL AGITATOR for any type of operation you're likely to need—from the smallest rated capacity to the largest installation.

INTERNATIONAL can furnish either standard packed Stuffing Box or Mechanical Seals.—On Side Entering Mixers either Seal can readily be converted to the other, if desired, as shown in upper right hand illustration.

SHUT-OFF CONNECTION on side entering mixers allows repacking or replacement with either standard Stuffing Box or Mechanical Seals with a full head of liquid, without appreciable leakage.

New "International" Mechanical Seals

Specifically designed to resist corrosion, high temperatures and pressures—to seal toxic or flammable fluids perfectly without losses,—to reduce fire hazard, power, labor and repair costs, with much longer service and fewer shut downs. Certain applications show reduction of friction up to 83% over conventional packings—No scoring of shafts—permits specially designed sealing of gritty and abrasive fluids. Seals can be engineered for shaft rotation in either direction. Mechanical Seals can be furnished optionally at relative cost factor as desired.

INTERNATIONAL Stands back of its product with expert service help when you need it. INTERNATIONAL'S Quarter Century of complete coverage in the Chemical Agitation and processing field is your assurance of lasting satisfaction. Remember to investigate "INTERNATIONAL" when you want Guaranteed performance.

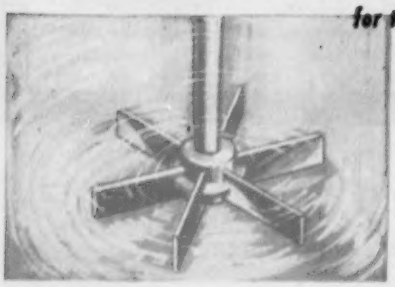
Any of the following Bulletins will be gladly sent on request. Simply indicate the subjects in which you are interested.

Technical Bulletins Available

Top Entering Agitators	73, 76, 76-A, 81
Side Entering Agitators	73-A
Portable Mixers	74-A
Mixing & Extruding Machinery	62-A
Dry Blenders & Ribbon Mixers	78
Grinding & Mulling Pans	5
Ball & Pebble Mills	100-A, 100-B
Laboratory & Pilot Plant Equipment	77-A
Stock Pans & Dust Boosters	109-A

TYPICAL INSIDE TYPE MECHANICAL SEAL

TYPICAL OUTSIDE TYPE MECHANICAL SEAL



for the best in mixing and processing—consult

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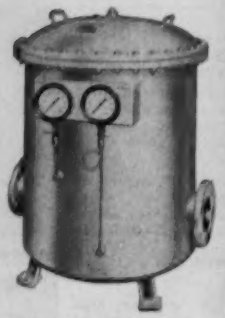
CFC COMPLETE FILTRATION COVERAGE

there's a Commercial Filters unit engineered for your filtering job...

Fulflo FILTERS



Fulflo Filters provide optimum clarity at ultra-high flow rates. For all industrial fluids—including oils, liquid fuels, chemicals, water, compressed air and various gases. Sizes to handle flow rates up to 1,600 gpm. Pressures to 4,000 psi.

Fulflo Filters feature Honeycomb Filter Tubes, the "precision controlled density" element that filters every drop again and again to give you microscopic clarity. Choice of cotton, acetate, nylon, orlon, dacron, dynel or glass fibres.

Standard models available in steel, stainless steel, rubber lined steel or nickel-plated brass. Custom models engineered to special requirements.

Honan Crane FILTERS

Honan-Crane Filters offer "clean oil" filtration in diesel, turbine, hydraulic, metal-working and quenching operations. Bulk refill models provide depth filtration with cellulose medium for additive oils and Cranite (fullers earth) medium for straigth mineral oils. Multi-cartridge models feature six different types of cartridges that may be used interchangeably depending on type and degree of filtration desired. Flo-Pac models, installed in line, handle flow rates up to 900 gpm. All have quick-opening covers for ease in changing refills.

other CFC products

Purivac Insulating Oil Conditioners
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Magnetic Separators
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FILTERS Michiana

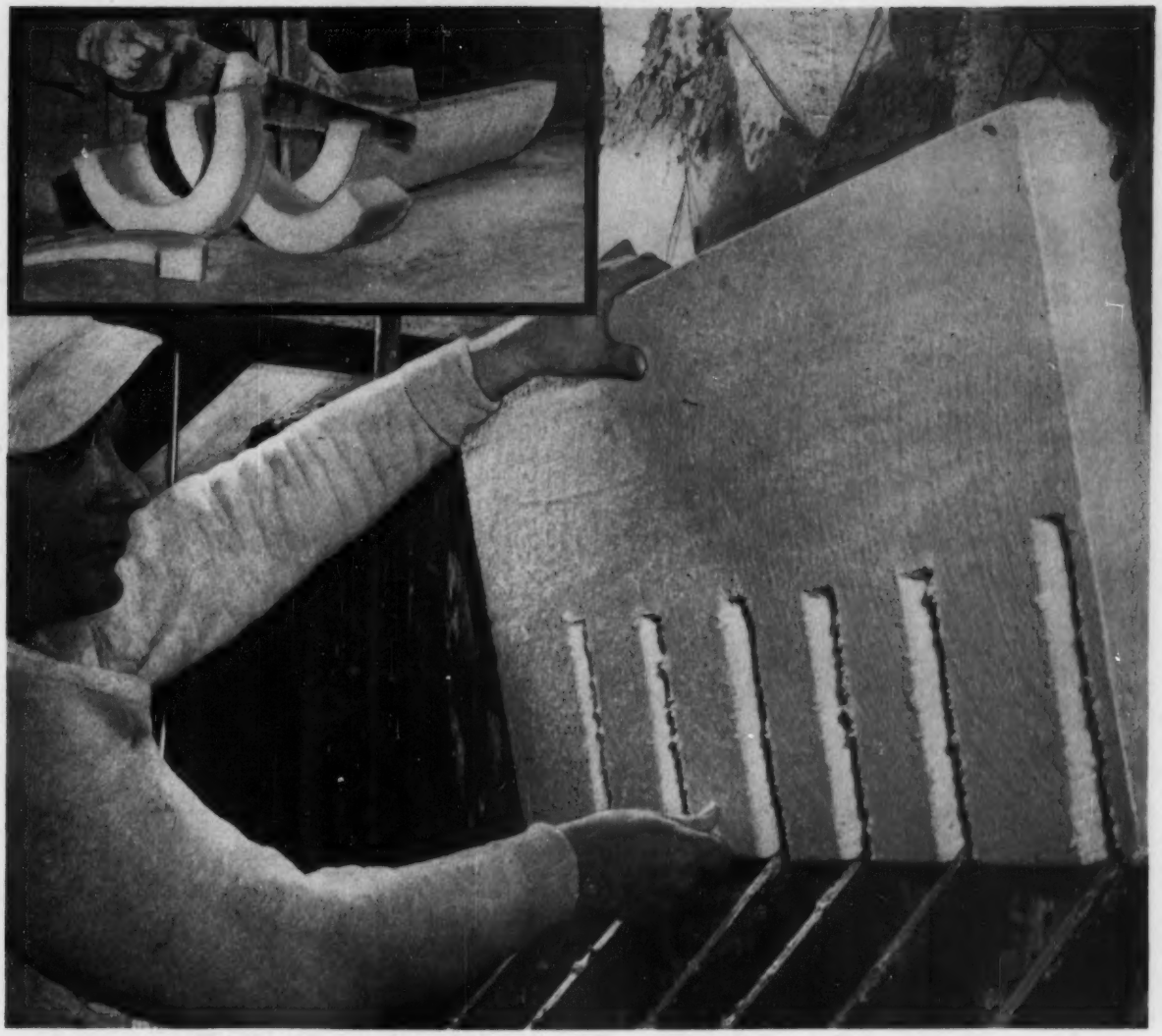
Diesel and gasoline engines get complete protection against the damaging effects of dirty oil with Michiana Lube and Fuel Oil Filters. Designed for low cost filtration and proven in thousands of installations. "Throw-away" or repackable filter elements. Available in a wide range of sizes and models.

Write for literature or engineering help covering your filtration problem.

CFC

COMMERCIAL FILTERS CORPORATION

MELROSE, MASSACHUSETTS • LEBANON, INDIANA



It's easy to install KAYLO *heat insulation!*

For easy handling and fabrication *on the job*, no other high temperature insulation beats Kaylo® and new Kaylo-*20* . . . *or installs so fast!*

Kaylo's compressive and flexural strength is unequaled—yet it's light, and easy and economical to work with. Cut an intricate fitting with ordinary tools—it's dimensionally stable, non-crumbling . . . won't break down even after repeated soakings!

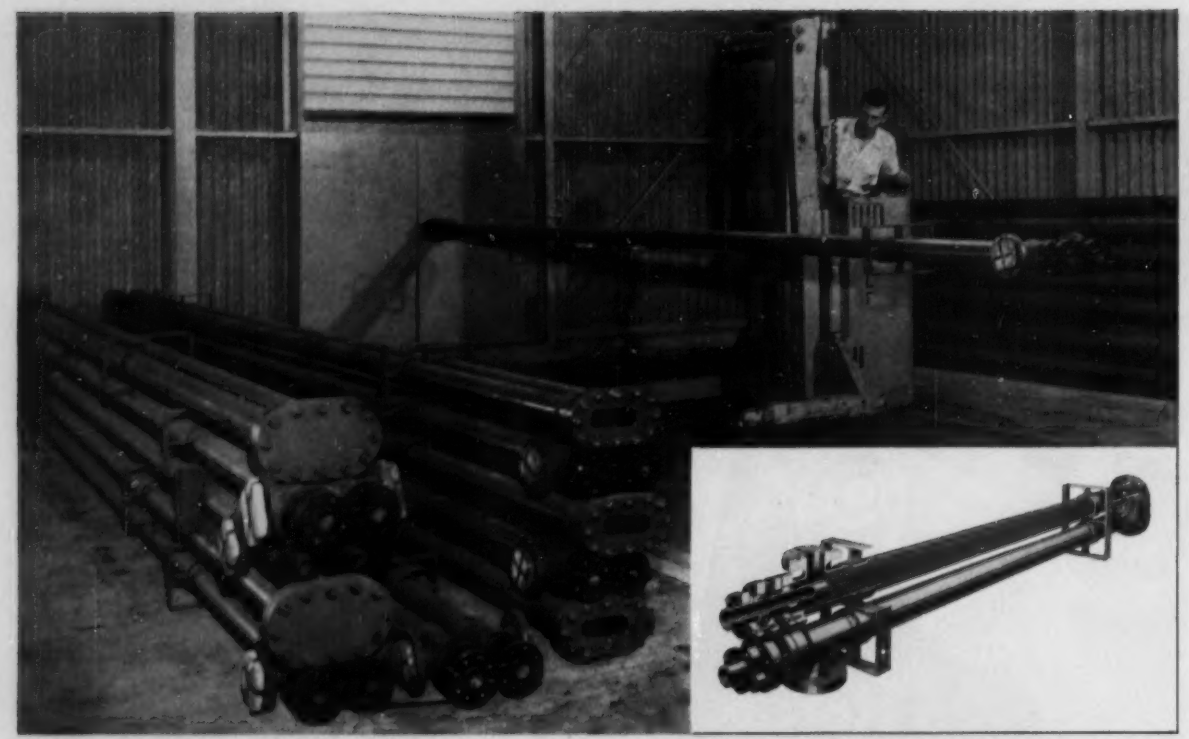
Kaylo heat insulations come in a wide variety of shapes, sizes and thicknesses—serve every type of high temperature application with top thermal efficiency. With new *pink* Kaylo-*20*, you can now cover the extra-high temperature range to *1800°F.*—including catalytic cracking units, refractory wall backing for furnaces and boilers, and fireproofing of piping, equipment, and vessel skirts.

Kaylo heat insulations are distributed by Owens-Corning Fiberglas Corporation. With the other Fiberglas* industrial insulations, they complete the most versatile, maintenance-free family of plant insulations available—all from *one* dependable source. See *Sweet's Files, Chemical Engineering Catalog* or *The Refinery Catalog*. Or write: Owens-Corning Fiberglas Corporation, Dept. 97-K, Toledo 1, Ohio.

FIBERGLAS, KAYLO and KAYLO-*20* now provide complete insulation coverage from sub-zero to 1800° F.!

OWENS-CORNING
FIBERGLAS

*T-M. (Reg. U.S. Pat. Off.) Owens-Corning Fiberglas Corporation
®T-M. Owens-Illinois Glass Co., Inc., mfr. of Kaylo.



ALCOTWINS are stocked at Beaumont, Tex., warehouse. Units derive unequalled heat-transfer characteristics from fused metal-to-metal bond between the "U" shaped fin channels and the tube. ALCO's heliarc weld provides efficient, continuous bond.

NOW FIN TUBE ALCOTWIN® EXCHANGERS CAN BE BOUGHT "OFF THE SHELF"

ALCOTWIN Units, In Many Combinations of Tube and Fin Materials, Are Stocked In New ALCO Beaumont Warehouse for Immediate Delivery

For most process applications you'll find ALCOTWIN heat exchangers in stock right now at ALCO's new Beaumont, Tex., warehouse. "Off-the-shelf" purchase of these highly versatile units can materially lower your costs in revamping processes or in building for new processes.

Many combinations of tube and fin materials are in stock. ALCOTWIN standard parts, in almost every material, are available for high-pressure and high-temperature combinations—resulting in real economy in special services.

Building-block flexibility of the ALCOTWIN units can be used to meet your present process conditions, and future load and process requirements can be accommodated easily by rearranging units.

Look into the ALCOTWIN. ALCO sales offices, and Power Machinery Corporation offices in the Southwest, have complete information. Or write P. O. Box 1065, Schenectady 1, N. Y., for brochure.

ALCO

ALCO PRODUCTS, INC.
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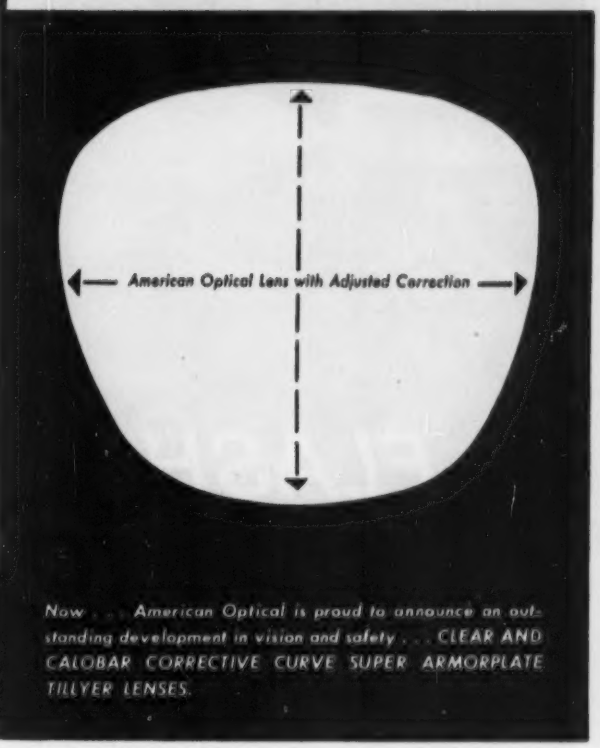
ALCOTWIN Sales Agents: Power Machinery Corp.

Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil-Field Equipment

Now Another AO—"First"!

Balanced Vision in Safety Rx Glasses



Now . . . American Optical is proud to announce an outstanding development in vision and safety . . . CLEAR AND CALOBAR CORRECTIVE CURVE SUPER ARMORPLATE TILLYER LENSES.

AO Ultrascopic Safety Glasses with Balanced Vision are the Ultimate in Eye Protection

There are over 420 combinations in the American Optical line of metal (F5100 series) and plastic (F9500 series) safety glasses. You can give every worker the type of eye protection he needs. You can fit any worker. SEE THESE SAFETY GLASSES WITH BALANCED VISION — call your nearest American Optical Safety Products Representative.

The Big Benefit is BALANCED VISION

With "compensated" or balanced vision throughout the lens, the worker obtains optimum seeing qualities from his glasses whether he looks up, down, laterally or straight ahead. Naturally, this "balanced vision" will increase visual efficiency and safety on the job . . . reduce production and eye accident costs. This advance is available in all regular prescription ranges.

DR. EDGAR D. TILLYER, Internationally recognized Dean of Ophthalmic Lens Design.

Facts about the AO TILLYER Principle of ADJUSTED CORRECTION

Lenses which interpret the services of the ophthalmic profession should be constant in R power from center to edge. Such constant R power depends upon achieving a balance between marginal sphere and cylinder characteristics of the lens. For over thirty years the Tillyer Principle has been the accepted standard in achieving this balance. Now, new computations make it possible to apply the well-known Tillyer principle to safety thickness S.A.P. Lenses.

Electronic computing gives a new scientific dimension to lens perfection. This advance for the first time is adapted to safety lenses and is now available with American Optical eye protection equipment.

Write for descriptive literature just off the press!

American Optical COMPANY
SAFETY PRODUCTS DIVISION

Always insist on the AO trademark on lenses and frames.

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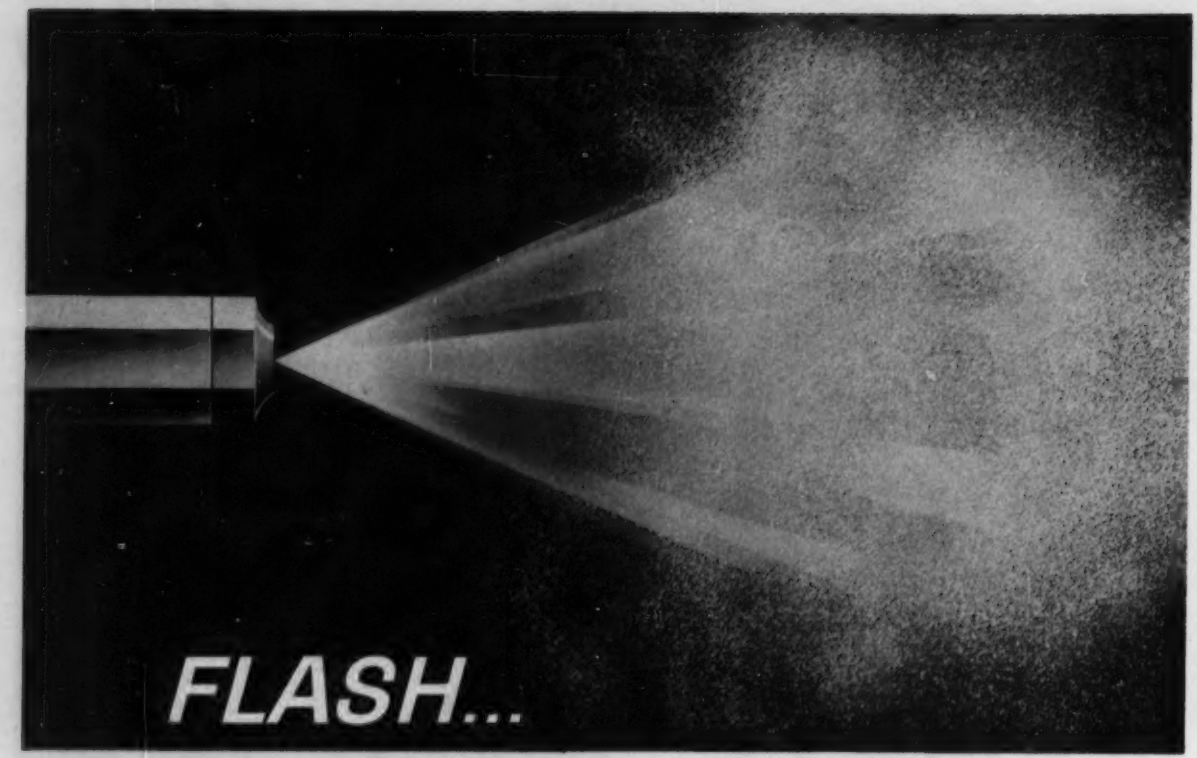


and it's dry
with a Buflovak SPRAY DRYER

Gives chemicals, pharmaceuticals, food products NEW characteristics . . . NEW markets

From liquid to dry product . . . instantaneously . . . and at minimum cost . . . in compact but accessible equipment that is easily and economically maintained . . . those are some of the advantages *Buflovak* SPRAY DRYERS provide.

A dry product is produced instantaneously in a *Buflovak* SPRAY DRYER. The liquid is atomized and sprayed into the center of a hot air stream. Evaporation occurs instantaneously and the dried product is removed from the heating zone so quickly that all its desired characteristics are retained. The operation is fast, sure and economical.

Our engineers will gladly analyze your drying problem and make sound, practical recommendations based on your requirements. A pretest of your product in the Buflovak Research Laboratory and Testing Plant can be arranged. Complete information on request.

Cost-cutting FEATURES of the Buflovak SPRAY DRYER

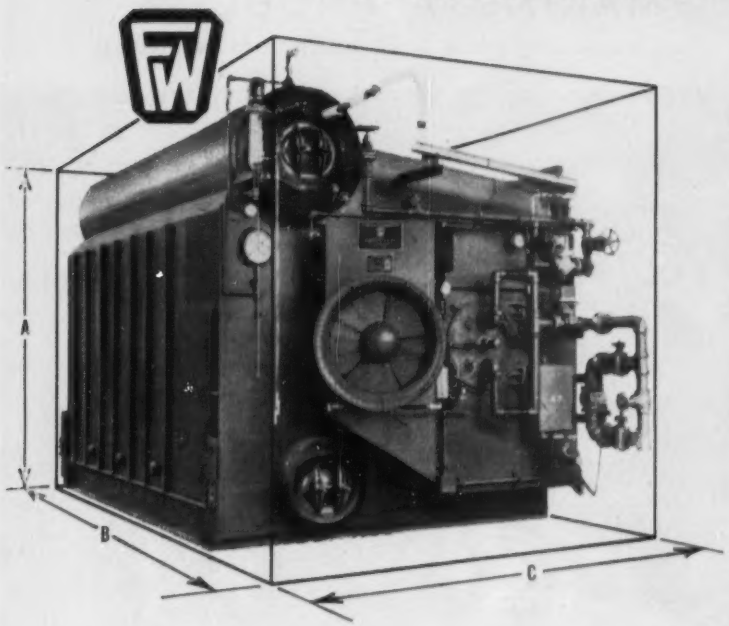
- HIGH RECOVERY OF SOLIDS—by the most efficient collecting system
- LOW INITIAL COST—compact equipment, easily fitted into existing building
- LOW COST OF OPERATIONS—low power and heat consumption
- EASY TO CLEAN—complete accessibility
- LOW MAINTENANCE COST—only a few moving parts . . . no filters or bags to replace
- CONTROLLED CHARACTERISTICS OF THE DRY PRODUCT—suitable for market with or without further processes . . . ready for immediate use

ASK FOR BULLETIN NO. 373

BLAW-KNOX COMPANY
Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, N. Y.

SAVE TIME · SAVE SPACE · SAVE MONEY

. . . with the new Foster Wheeler



PACKAGED STEAM GENERATOR

CAPACITY RANGE AND DIMENSIONS

CAPACITY lb/hr Based on 100 psi, 212F Feedwater and Zero Blowdown		A	B*	C
#6 OIL FIRED	NAT. GAS FIRED			
13,400	12,900	12′ 1¼″	14′ 6¾″	10′ 11¼″
15,600	15,000	12′ 1¼″	15′ 7½″	10′ 11¼″
17,800	17,100	12′ 1¼″	16′ 8¼″	10′ 11¼″
20,000	19,200	12′ 1¼″	17′ 9″	10′ 11¼″
21,800	20,700	12′ 1¼″	18′ 9¾″	10′ 11¼″
24,000	22,800	12′ 1¼″	19′ 10½″	10′ 11¼″
26,200	24,900	12′ 1¼″	20′ 11¼″	10′ 11¼″
28,400	27,000	12′ 1¼″	22′ 0″	10′ 11¼″
30,600	29,100	12′ 1¼″	23′ 0¾″	10′ 11¼″
32,800	31,200	12′ 1¼″	24′ 1½″	10′ 11¼″
35,000	33,300	12′ 1¼″	25′ 2¼″	10′ 11¼″
37,200	35,400	12′ 1¼″	26′ 3″	10′ 11¼″
39,400	37,500	12′ 1¼″	27′ 3¾″	10′ 11¼″
41,600	39,600	12′ 1¼″	28′ 4½″	10′ 11¼″
43,800	41,700	12′ 1¼″	29′ 5¼″	10′ 11¼″
46,000	43,800	12′ 1¼″	30′ 6″	10′ 11¼″

**Varies with method of firing and type of combustion controls. Figures listed provide safe approximation over firing and forced draft equipment.*

HERE'S a *complete line* of packaged steam generating units that are built to power boiler standards . . . designed and constructed to offer these important savings.

You *save time* because they are shipped completely assembled, all ready to set on a simple foundation and connect to your fuel, steam and electric power lines.

You *save space* because all packaged units are extremely compact — designed for shipment on standard railroad flat cars. They provide high output in lowest possible installation space consistent with safe rates of heat liberation.

You *save money* because all units are shop fabricated from standard parts, simple to install, and designed for sustained high efficiency and exceptional ease of inspection and servicing.

Construction features include: 36″ steam drum and 24″ water drum — staggered boiler tubes — closely spaced waterwall tubes — effective circulation — light, highly efficient refractory and insulation — wide choice of burners and controls — baffled steam collector.

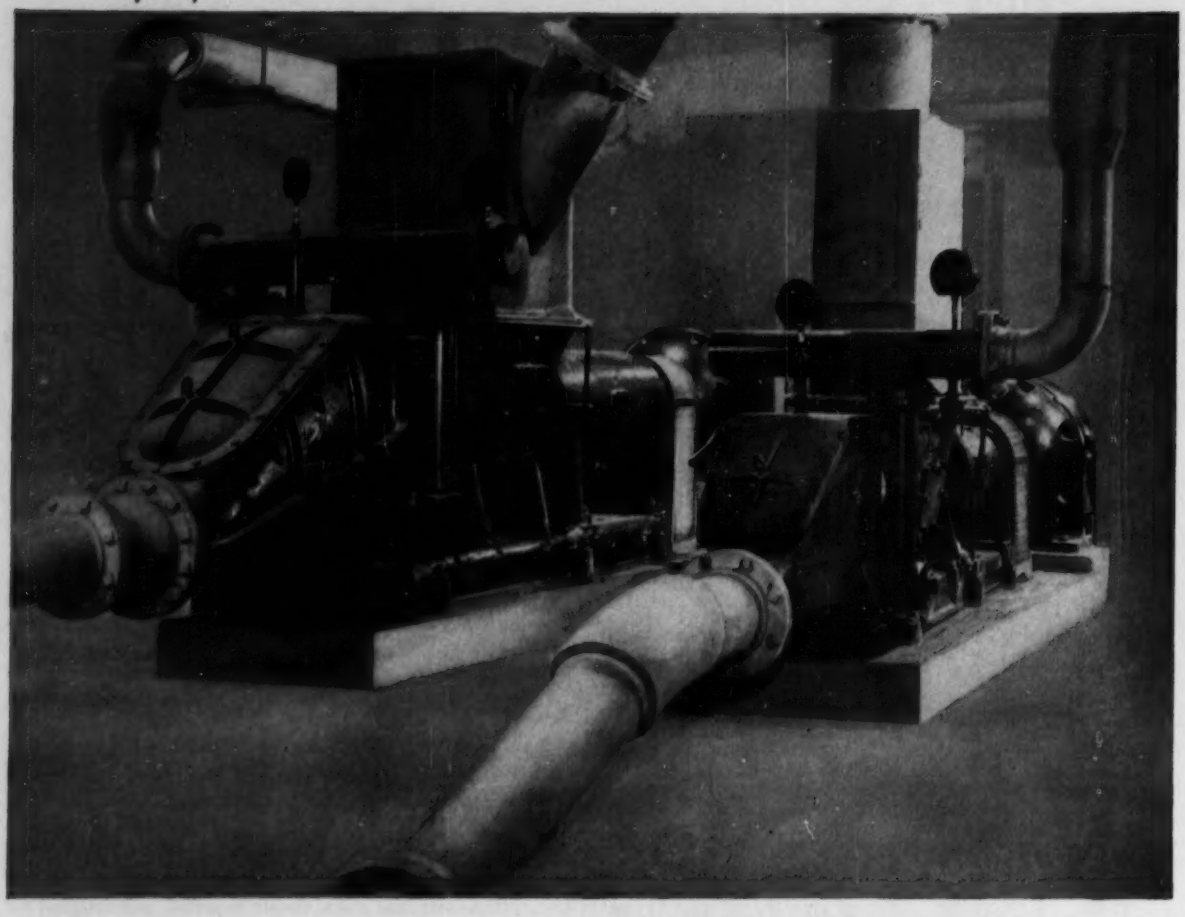
In addition to the standard units listed here, FW Packaged Steam Generators are also available for design pressures to 1300 psi, with superheaters giving up to 825 F final steam. FW extended surface economizers provide maximum efficiency at these higher pressures and temperatures. For complete information send for Bulletin No. PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

STOP MAKING A PROBLEM

. . . out of your bulk materials handling



Sure, your dry bulk materials handling system might break down now and then. Yes, maintenance costs do seem to be on the rise. But the materials must be moved even though the handling operation itself adds not a penny to the profit side of the ledger.

Obviously, the solution to all this is to move your materials as efficiently and economically as possible—with a Fuller-Kinyon Conveying System designed specifically for your operations.

Air does the work, conveying to storage, and from storage to packer bins, process, cars, ships and barges, with maximum efficiency, cleanliness and safety. A Fuller-Kinyon System also will unload from cars, trucks, ships or barges. A one-man operation, with low maintenance, it can be remote or automatically controlled, and used anywhere a pipeline can be run.

Higher, sustained production is possible—and at reduced cost. Write now for the proved-in-service facts about Fuller-Kinyon. A Fuller engineering study of your operations, with recommendations, can be yours without cost or obligation.

P-164
3020

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Chicago · San Francisco · Los Angeles · Seattle · Kansas City · Birmingham

Fuller
. . . . pioneers in harnessing AIR

Titanium Tubing

For processing lines carrying fluids of an extremely corrosive nature — look to *Contour Trentweld* titanium tubing for reliable service.

This titanium tubing is completely uniform throughout any cross-section. The weld zone is free from bulging weld bead because Trent's exclusive process — performed with the weld area at the bottom — forms the molten weld metal into the shape of the tubing.

And, with titanium, you get the unique advantages of a tubing that's strong as steel but 44% lighter . . . virtually immune to a broad spectrum of corrosive materials . . . entirely free from stress-corrosion cracking.

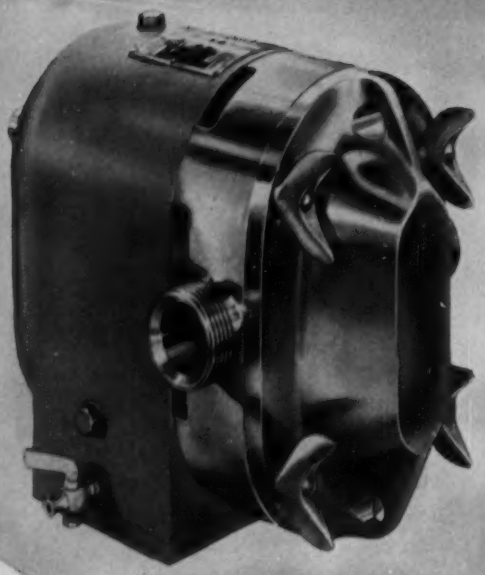
So, next time you need a strong, light, extremely corrosion-resisting tubing — try *Contour Trentweld* titanium tubing. And remember, it's made by Trent — tube mill specialists.

CONTOUR TRENTWELD®

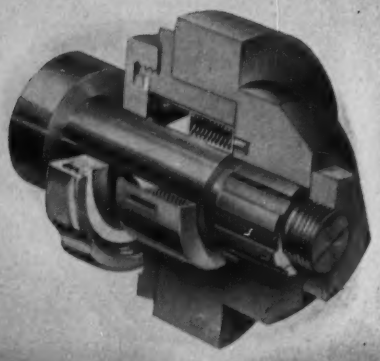
Stainless and High Alloy Welded Tubing

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of Crucible Steel Company of America)

NOW MINIMUM LEAKAGE PUMPING CORROSIVE SOLUTIONS . . .



with a Waukesha Pump... using a John Crane Seal



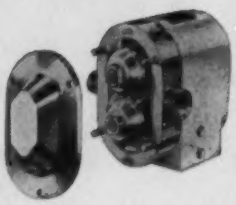
Note, too, these other outstanding pump features to speed plant production and lower operating costs

Positive Displacement and Slow Speed

No product damage ... no aeration ... no agitation.

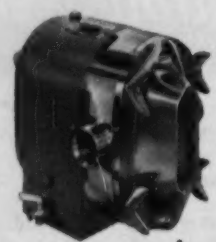
Sturdy Construction

Designed for long life, a minimum of maintenance.



Corrosion-Resistant

No product contamination ... no impairment of flavor.



Sanitary

Easy to clean, especially when changing product runs while using the same pump.

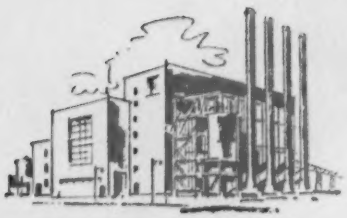
● Designed for a "tough" pumping job in the chemical industry, where volatile, corrosive, or hot materials are being transferred, is the Waukesha positive displacement pump with the spring-loaded, John Crane Rotary Seal. Incorporating carbon, ceramic, and teflon, this seal is recommended for non-abrasive products having corrosive properties.

Waukesha positive displacement, corrosion-resistant, stainless steel pumps are renowned for their precision performance and dependable operation in many industries. These pumps require a minimum of time to dismantle, clean and assemble. They are easy to wash and sterilize ... a valuable asset where pumps are used to handle various products one after another. Write the Waukesha Foundry Company, Dept. P, Waukesha, Wisconsin, for complete details.

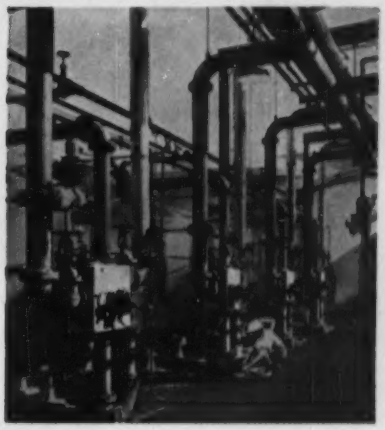
Waukesha Foundry Company

WAUKESHA—
the forward look in pumps.
Yesterday, Waukesha pioneered the Sanitary P. D. Pump. Today, Waukesha pioneers the improvements.

First in water conditioning

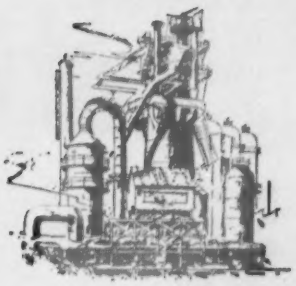


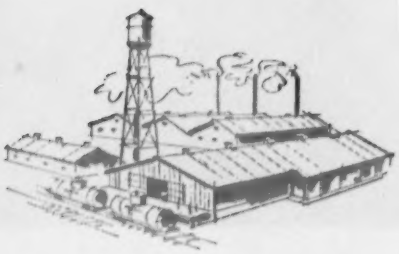
This Giant Cochrane Sodium Zeolite Plant at Rayonier, Inc., consists of 11 units 10'0" in diameter and 5'0" high. Automatically controlled with Cochrane Hydromatic Valves, these units are capable of treating up to 11,000,000 GPD.



Cochrane *automatic* Zeolite Softening

at RAYONIER'S GIANT JESSUP PLANT





To produce high-quality cellulose requires high-quality water. At Rayonier's Jessup, Ga. plant, more than 20 million gallons of water are softened daily—and all of it softened automatically to zero hardness by 11 Cochrane Zeolite Softeners.

The softeners in this installation are controlled by Cochrane Hydromatic Valves, which in turn are controlled by Cochrane Automatic Timers. Every phase of the cycle—service, backwash, regeneration, rinse and back to service are all automatically controlled.

Zero hardness water is guaranteed. There is no possibility of error in operation or of contaminating the treated water.

Cochrane's leadership in water conditioning, and its complete line of equipment assure you unbiased recommendations for equipment to performance requirements. For complete information on Cochrane Zeolite Softeners, write for Publication 4520-A.

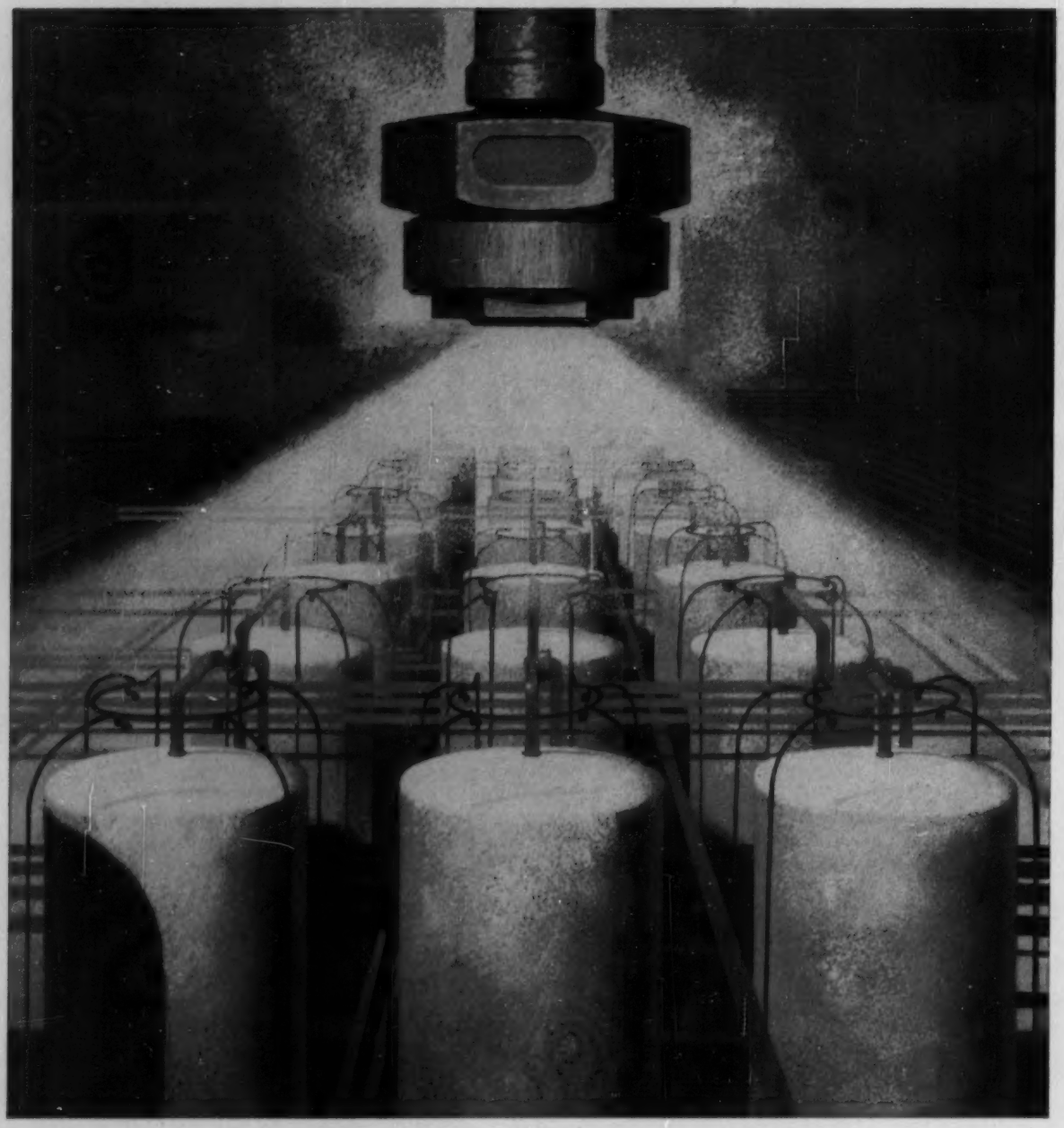
VISIT OUR POWER SHOW BOOTHS
NOS. 426-428

Cochrane
CORPORATION
3113 N. 17TH STREET, PHILADELPHIA 32, PENNA.
NEW YORK • PHILADELPHIA • CHICAGO

Cochrane Water Conditioning Ltd., Toronto 4; Montreal 1, Canada
Representatives in 30 principal cities in U.S.; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii; Manila, Philippine Islands.
Pottstown Metal Prods. Div.—Custom built carbon steel and alloy products.

COCHRANE CORPORATION · WATER CONDITIONING ENGINEERS SINCE 1863 · PHILADELPHIA

Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters
Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties



give your plant and equipment the best fire protection— a BLAW-KNOX automatic fog system

BLAW-KNOX Automatic Fire Protection Systems are engineered to provide positive protection for your plant and processing, storage, and other equipment. If a fire breaks out, the system goes into action immediately:

- alarms sound
- fire smothered *promptly*
- heat dissipated by *cooling* action
- pressure build-up prevented

Why not give your plant and equipment the BEST possible protection. Let a Blaw-Knox *fire-protection* Engineer study your needs. He will gladly submit a layout and a cost estimate . . . with no obligation to you.

"Little Joey Sprinkler always on the job"

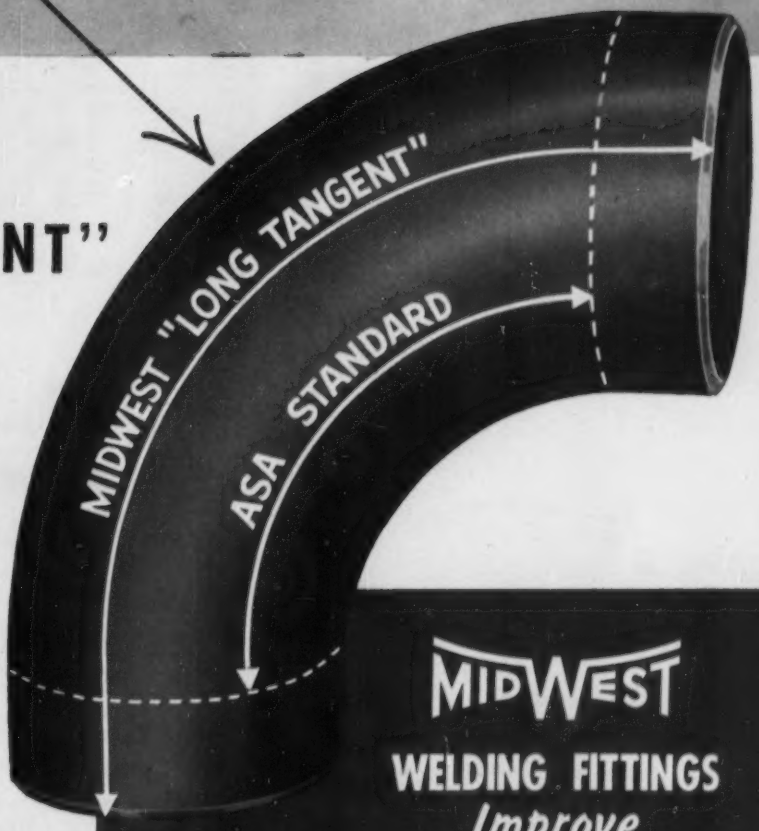
50th Anniversary BLAW-KNOX 1906-1956

BLAW-KNOX COMPANY
Automatic Sprinkler Department
Pittsburgh 33, Pennsylvania

King Size (but at no extra cost)

MIDWEST

"LONG TANGENT" ELBOWS



Among all standard welding elbows, only Midwest "Long Tangent" Elbows can be described as "*King Size*" . . . only they have the long straight ends which equal ¼ of the nominal fitting diameter (a 12" Midwest "Long Tangent" Elbow has tangents 3" long). This greater length is responsible for significant savings on many piping systems (see advantages listed below). For additional information, ask your Midwest distributor or write us for Catalog 54.

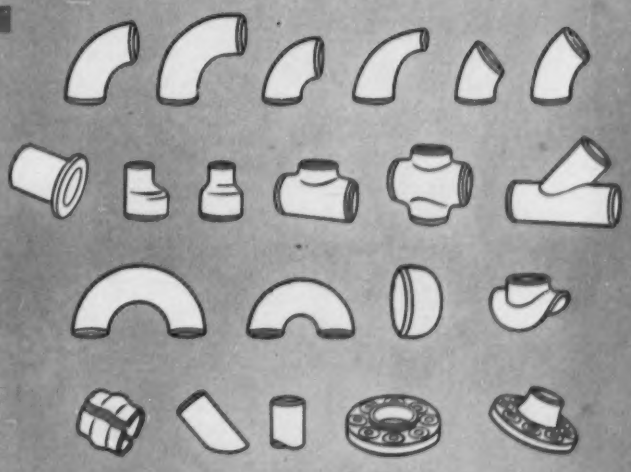
MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Clifton, N. J., and Los Angeles

Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St. • Cleveland 14—616 St. Clair Ave. • Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg. • Miami 34—2103 Le Jeune Rd. • Boston 27—426 First St. San Francisco 11—420 Market St. • Oneida, N. Y.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST
WELDING FITTINGS *Improve*
PIPING DESIGN and REDUCE COSTS

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

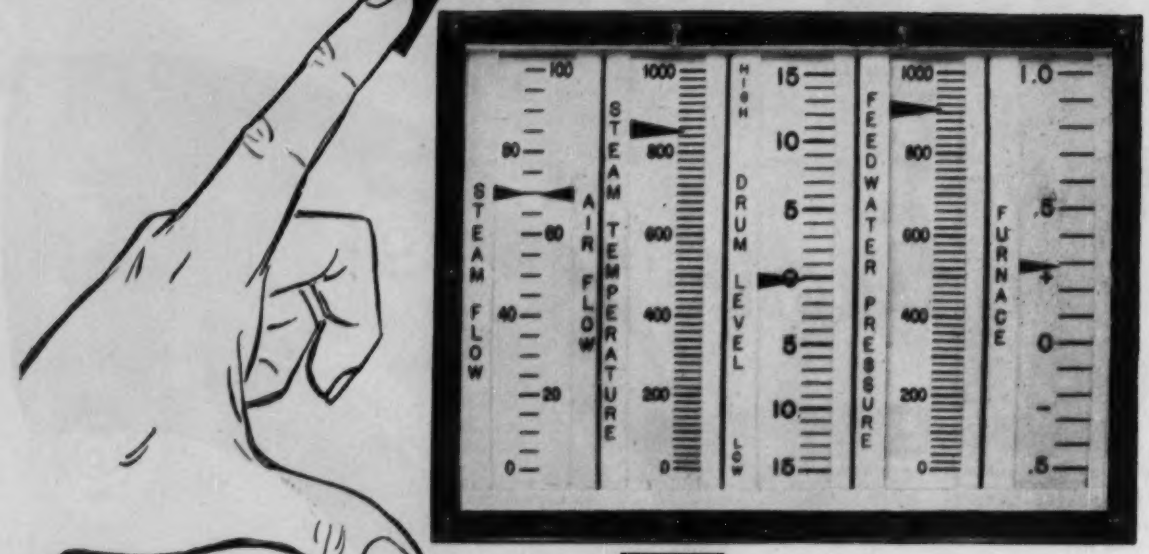


MIDWEST HAS THE MOST COMPLETE LINE

7323

announcing

a new line of **small-size easy-to-read** gauges and receivers



NEW **REPUBLIC 5 GAUGES**

Individual, Independent Measuring Units for
DRAFT • PRESSURE AND VACUUM • DIFFERENTIAL PRESSURE • TEMPERATURE
High Accuracy Receivers for Pnuematic Transmitters and Electric Meters Measuring
FLOW • PRESSURE • CO_2 • DENSITY • LIQUID LEVEL • OTHER PROCESS VARIABLES

Important Features

- FIVE INCH ILLUMINATED SCALES
- INDEPENDENT, INTERCHANGEABLE UNITS
- MULTIPLE OR INDIVIDUAL MOUNTING — from one to eight units to a single case
- EASILY MOUNTED—no panel drilling necessary in most cases
- SCALES EASILY CHANGED OR COLOR-CODED
- POINTER MOTION REVERSIBLE
- SIMPLIFIED CONNECTIONS AT BACK OF CASE
- REMOVAL FROM FRONT OR BACK

Now you don't have to sacrifice instrument performance and readability to size considerations. With Republic's new line of small-size V5 Gauges, you can save panel space, make more compact instrument groupings and *still* get the accuracy, sensitivity and readability you would expect from conventional sized instruments. Full sized diaphragms, bellows and helix units in V5 Gauges assure "big" gauge performance in an instrument that requires only one-fourth the panel space of conventional gauges. Five inch scales are almost flat and are indirectly illuminated as a standard feature for easy reading — even from a distance.

• *Write for New V5 Bulletin* ▶

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy., Chicago 47, Illinois

NEW in Design ... Performance ... Economy

ALLIS-CHALMERS
Stainless Steel
GYRATORY SCREEN

Stainless Steel Construction makes cleaning easy ... is corrosion resistant.

Large Screening Capacity. Self-contained unit provides as much as 35 square feet of screening area in 16 square feet of floor space. Gyratory action exposes product to all of screen cloth.

Wide Sizing Range permits handling of product sizes from 4 to 200 mesh.

Extra Cooling Surface of rib-type motor eliminates insulation burnouts under normal operating conditions.

Simplified Dismantling. Vertically locked deck arrangement eliminates need for enclosure. External tie rods facilitate fast removal of decks.

No hard-to-clean Nooks and Corners.

Dust-Tight — wide variety of installation-proved materials available for compression-type seals.

Two, Three, Four Separations ... one outlet for each different size product. Collars and adjustable changes provide for quick attachment of flexible outlet tubes.

Full Freedom of Gyratory Motion made possible by universal-type stabilizers. No lubrication needed.

Low Power Requirements. A 1-hp motor drives unit of three or four decks.

Quiet, Vibrationless Operation assured by dynamically balanced mechanism.

Product Quality Protected. Gentle motion minimizes disintegration of foreign particles.

Secure, Vibrationless Foundation provided by sturdy, all-welded steel base.

You Get MORE When You Specify ALLIS-CHALMERS

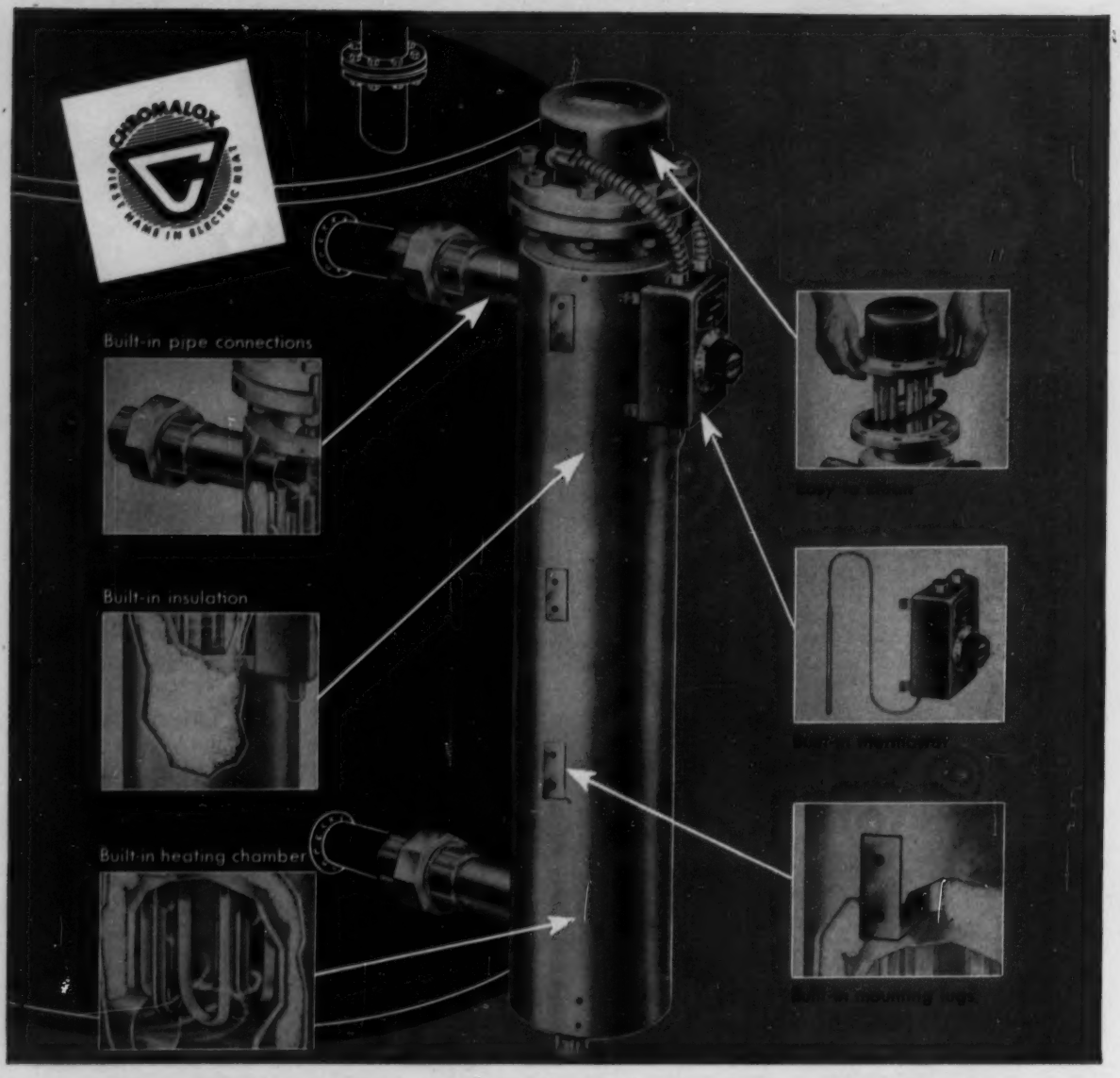
Top efficiency in screening ... maximum capacity ... profit-insuring quality control ... quick 'n' easy sanitation ... simplified maintenance ... economical operation — all these important advantages are yours when you specify Allis-Chalmers.

Your Allis-Chalmers representative will be glad to tell you more about this newest and finest of gyratory screens. Call him. Or write for descriptive Bulletin 07B8446. Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5074



Compact, packaged Electric heating for Liquids and Gases!

Chromalox Electric Circulation Heaters are completely packaged heat exchangers designed for a wide variety of liquid and air heating jobs. In them, you get a complete, compact heating package ready for quick, economical installation. All you do is make the necessary pipe and electrical connections.

What's more, you get all the advantages of electric heat—including accurately maintained heat at the temperatures you select, instant heat-up, without elaborate facilities . . . and high efficiency because you generate heat right at the job.

Compared with fuel-fired systems, the low original cost and operating expense of Chromalox Electric Circulation Heaters helps you realize real dollar savings. There's no expensive firing and upkeep cost.

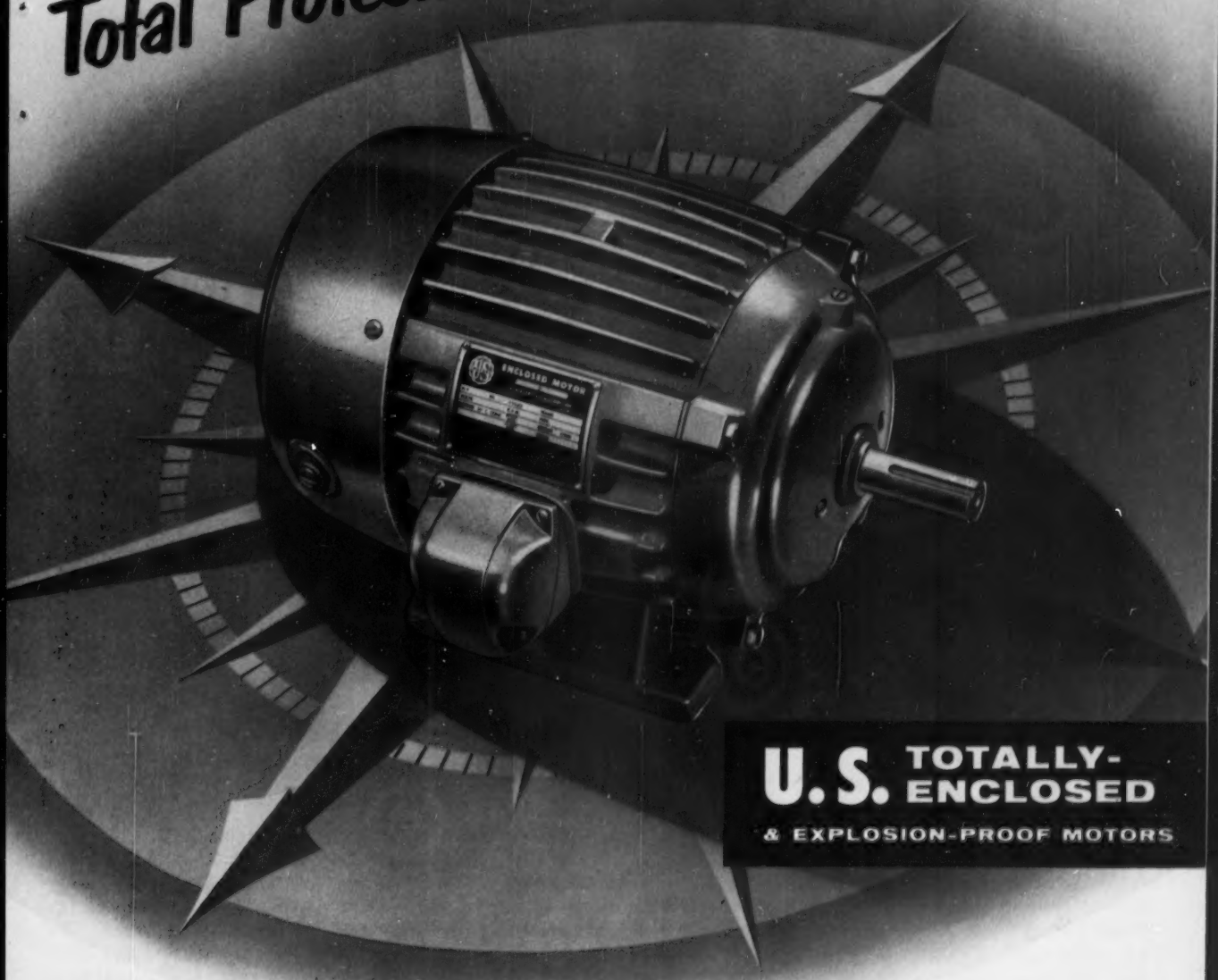
Whether you are heating water, oils, steam, air or heat transfer media, call your Chromalox representative—he's the man with the electrical answer to your heating problem. B-711

For the full story on Chromalox Electric Circulation Heaters, write for a copy of Bulletin 701.

Edwin L. Wiegand Company

7514 Thomas Boulevard, Pittsburgh 8, Pa.

Total Protection...in Every Direction



U.S. TOTALLY-ENCLOSED & EXPLOSION-PROOF MOTORS

Protected AGAINST EROSIVE POLLUTION...

...U. S. Totally-Enclosed and Explosion-Proof Motors provide all-around protection against corrosion, weather exposure, bad contaminants, caustic conditions, dust and erosive elements. All types are NEMA-dimensioned.

Protected AGAINST INTERNAL HEAT...

Asbestos protected windings, cooling ribs, and a heavy duty fan form outstanding features to give U. S. Totally-Enclosed motors maximum protection against heat.

Protected AGAINST BEARING FAILURE...

Lubriflush transverse re-Lubrication is possible without disassembly of motor or fan guard. Grease fittings are outside. Lubriflush forces out old grease and injects new lubricant around and through the bearings.

Protected AGAINST SHOCK AND VIBRATION

...The hefty cast-iron frame of the U. S. Totally-Enclosed motor is normalized to provide a non-stress, single-piece structure. Rugged feet are integrally cast with the frame; not welded on.

U.S. MOTORS — U.S. Electrical MOTORS

U. S. ELECTRICAL MOTORS Inc.
P. O. Box 2058, Los Angeles 54, Calif., or Milford, Conn. CE-11

☐ Send U. S. Totally-Enclosed Motor Bulletin #1879

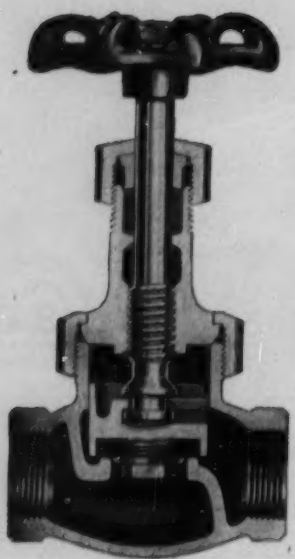
NAME_____

COMPANY_____

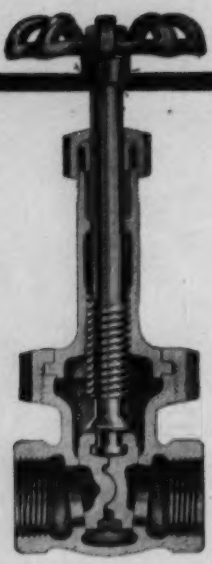
ADDRESS_____

CITY_____ ZONE____ STATE_____

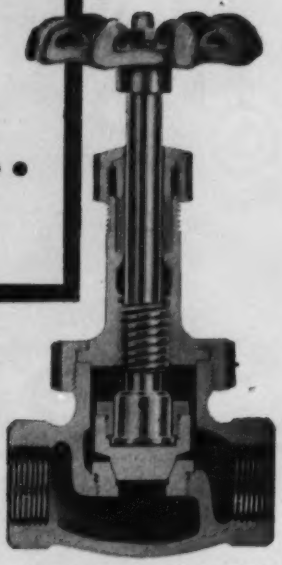
Walworth bronze valves...



Walworth No. 95 Globe Valve
Re-New-Disc



Walworth
No. 29 Gate Valve



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc

built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:

WALWORTH
valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

● Manufacturing ●● Manufacturing and product development ●●● Manufacturing, product development and research □●● Pilot manufacturing, product development and research

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	GPE CAPACITIES
●●●	●●	●●	□●●	●●	●●●		●●	●●●	●●	●●	●●	●●●	Precision Mechanics, Optical Devices, Ceramics
●●●	●	●			●●●		●●●	●●	●	●●	●	●●●	Electrical Equipment and Components
●●●	●●	●●●	●●●		●●●		●	●●		●●●	●●	●●●	Electronics
	●●			●●●		●●●				●●●			Hydraulics, Liquids Processing, Heat Exchange
●	●		●●●		●					●			Television: Studio, Theatre, Business, Institutional, Industrial
●●●	●	●●	□●●		●●●	●●●	●●	●●		●●●	●	●●●	Instruments, Servos, Controls: Hydraulic, Pneumatic, Magnetic, Electronic
●●●	●		●●●		●●●		●			●●	●	●●●	Aircraft and Missile Guidance, Control, Simulation
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●●●	●	●●	●●●		●●			●		●			Radar, Microwave, Ultrasonics
	●●●		□●●				●●	●●●	●●●		●●●		Motion Picture and Audio Equipment
●●●				●●						●●		●●●	Nuclear Power Components and Controls
●●●			●●●	●●●	●●●	●●●				●●●		●●●	SYSTEMS ENGINEERING

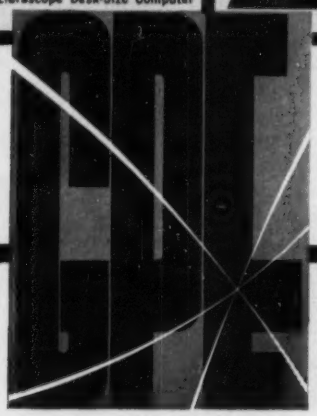
Librascope Desk-Size Computer

Link Aviation F-89D Jet Simulator

GPL Industrial-Institutional TV System

Griscom-Russell Shipboard Distilling Plant

Askania Electro-Jet Power Package



SYSTEMS ENGINEERING

The GPE Companies are leaders in that small, select group in American industry which is broadly qualified to develop and produce the systems needed today for defense and industry. GPE leadership accounts for some of the most advanced systems in use in business, television, aviation, marine, steel, oil, and other industrial fields.

In Systems Engineering, highly advanced capacities and resources are prerequisite. Yet, no matter how highly advanced, they are of little use if limited to a few areas. Finding optimum solutions to complex systems problems calls for *balanced competences*. And beyond that, success calls for the consistent application of such competences *at every stage* — beginning with research, and extending all the way through development, production and final testing.

No GPE company is limited by the boundaries of its own specialties. The basic GPE operating policy, GPE Coordinated Precision Technology, places at the command of each company in the group all GPE research, development and production facilities, and the skills and experience of the more than 2500 GPE technical men working in depth in the wide range of advanced capacities indicated in the chart above.

Behind each group working on a specific problem in one GPE company stands the whole group of GPE scientists, engineers and technicians with the answers — or the knowledge that will find the answers — to questions underlying and related to that problem. To the customers of GPE Companies this means that the concept and development of equipment, components and systems are not restricted or distorted by traditional allegiance to specific competences.

The five systems illustrated, while products of different GPE companies, are all examples of the consistent application of balanced competences, achieved through GPE coordination. For brochure describing GPE Coordinated Precision Technology and the work of the GPE Companies, or help on a specific problem, write: General Precision Equipment Corporation, 92 Gold Street, New York 38, N. Y.

GENERAL PRECISION EQUIPMENT CORPORATION

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(10) J. E. McAULEY MFG. CO. (11) ASKANIA REGULATOR COMPANY (12) AMPRO CORPORATION (13) LIBRASCOPE, INCORPORATED

there's a touch of imagination in every good construction job

Brains, experience, technical skills, are all fundamental qualities in a good builder. These we have here at Procon in full measure. But, we try to add that vital touch of imagination that helps us visualize the correct answer to exacting new problems and enhances our ability to get each project completed to schedule and to every requirement.

Anywhere in the world, Procon offers the oil refining, petrochemical and chemical industries a complete construction service. Whatever your requirements, from complete new plant construction to expansion, modernization or the addition of process facilities, let us talk them over with you. This is the first step to a job completed to your full satisfaction.

PROCON *Incorporated*

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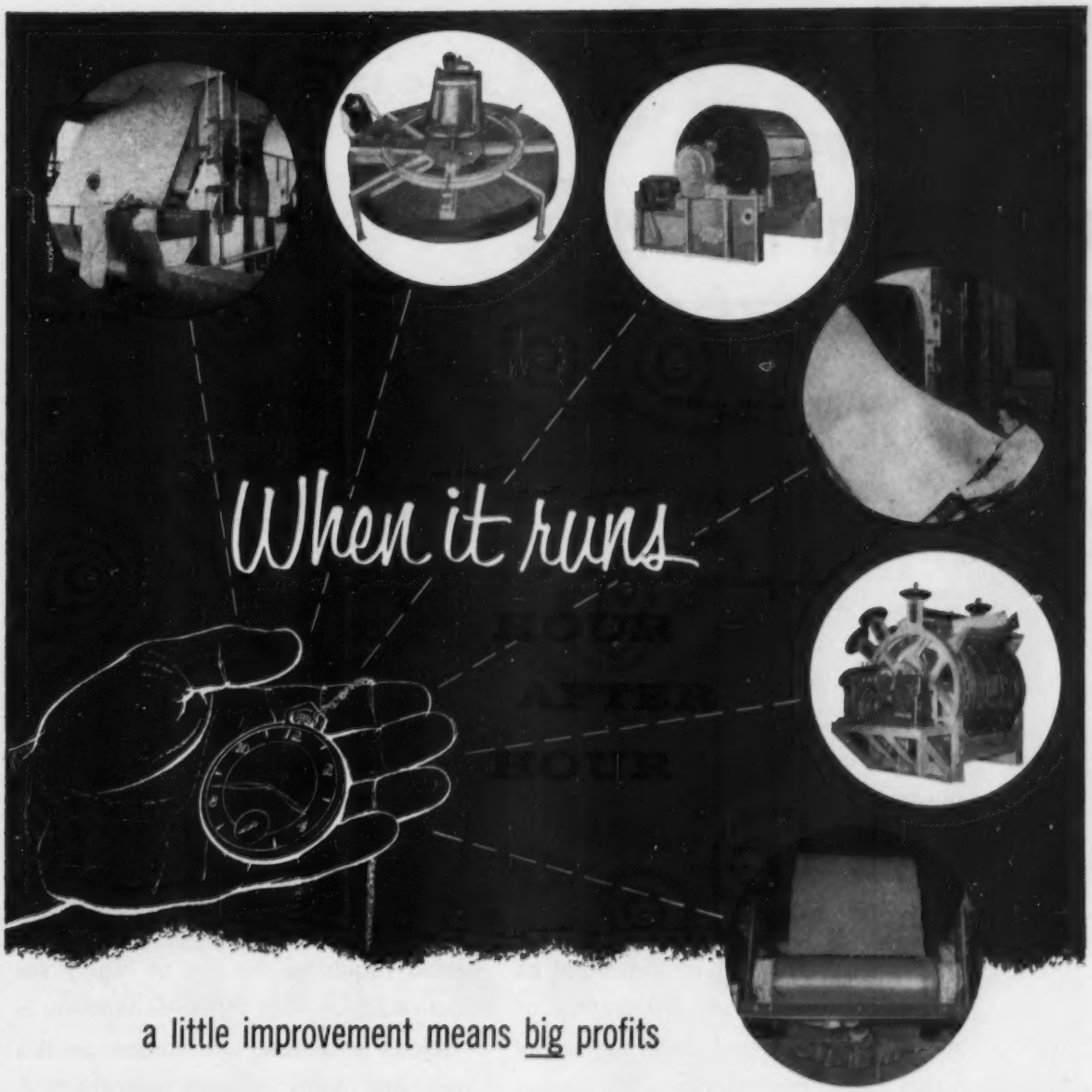
PROCON INTERNATIONAL S. A., SANTIAGO DE CUBA

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

PROCON



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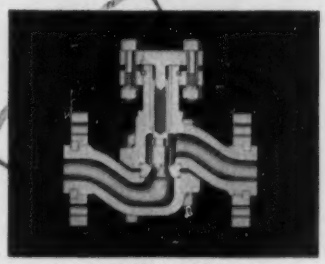
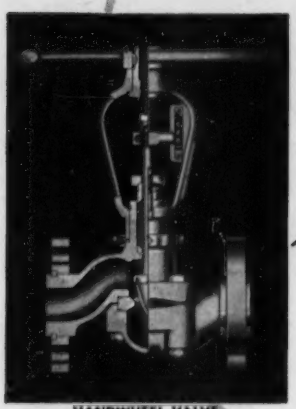


CHECK VALVE



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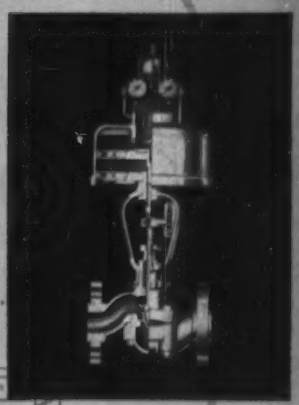

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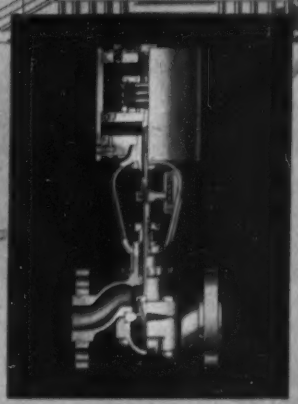

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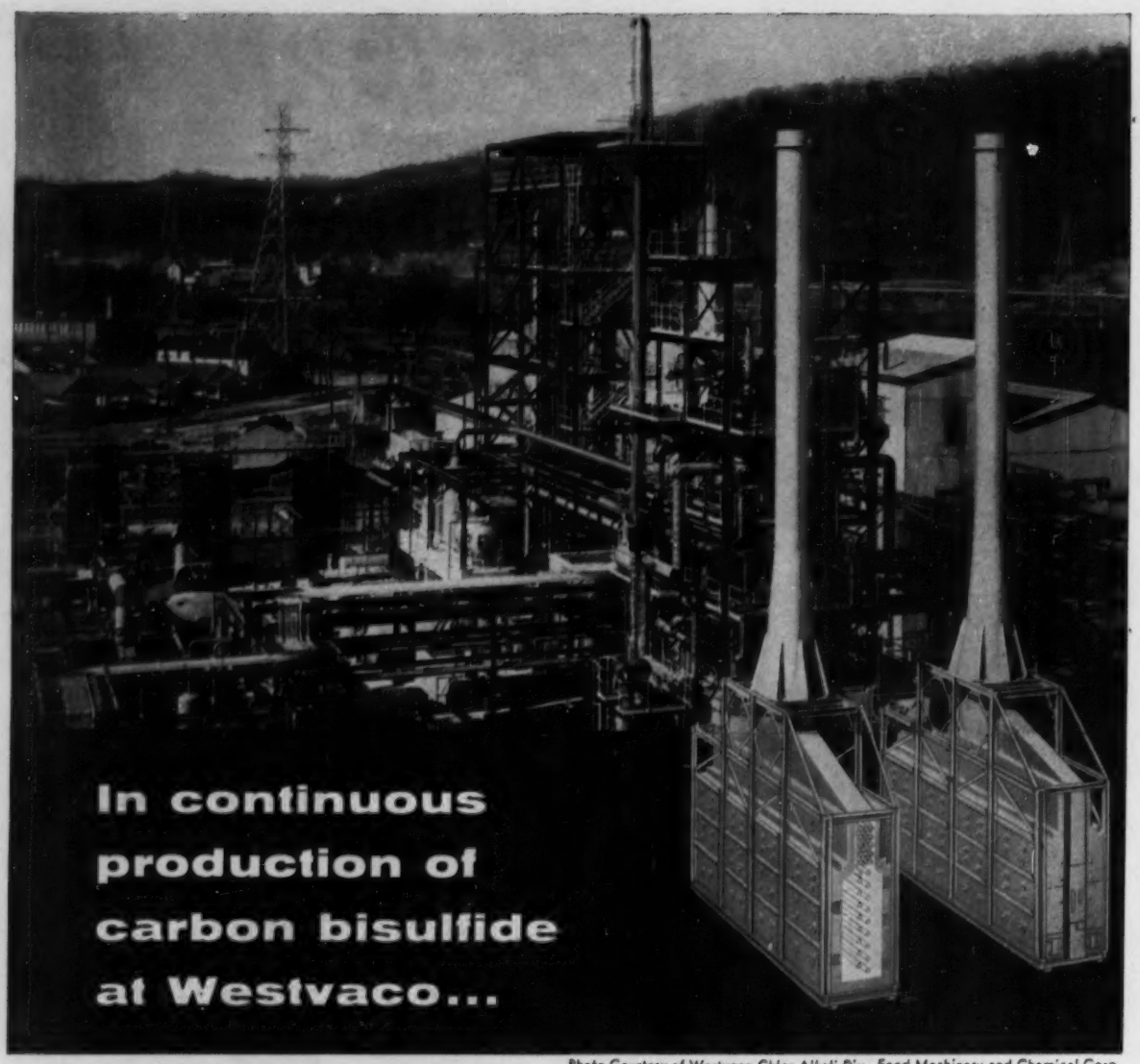

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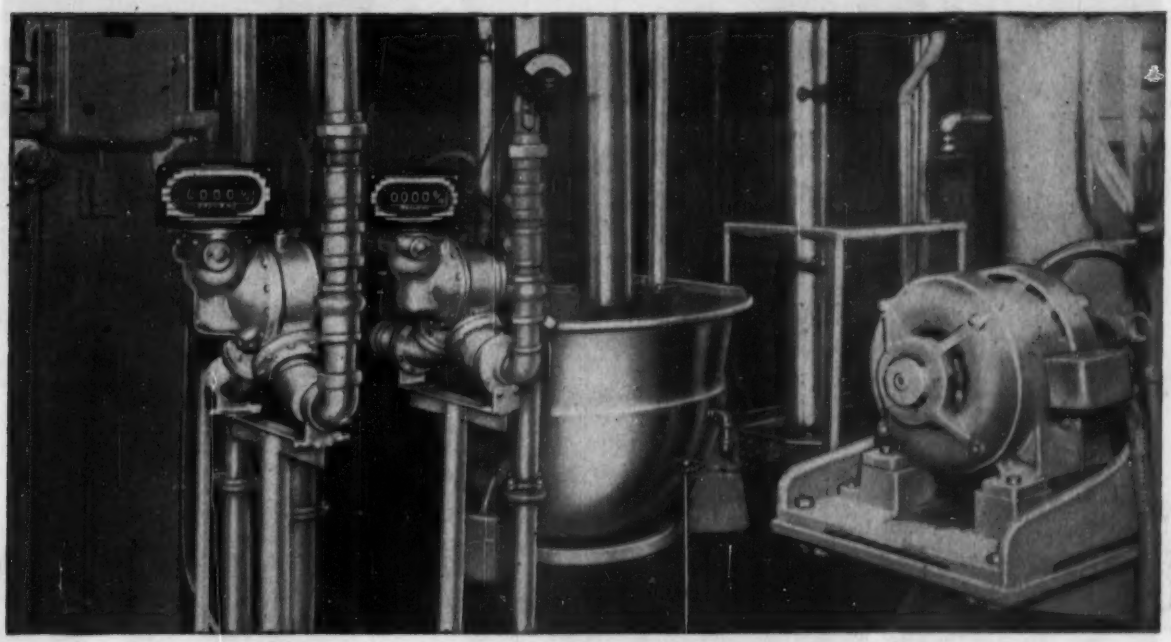

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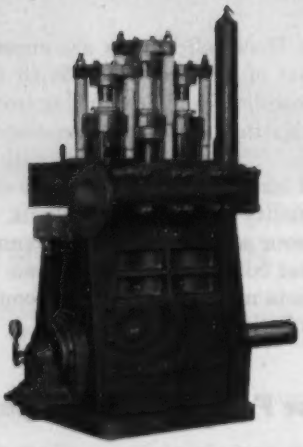

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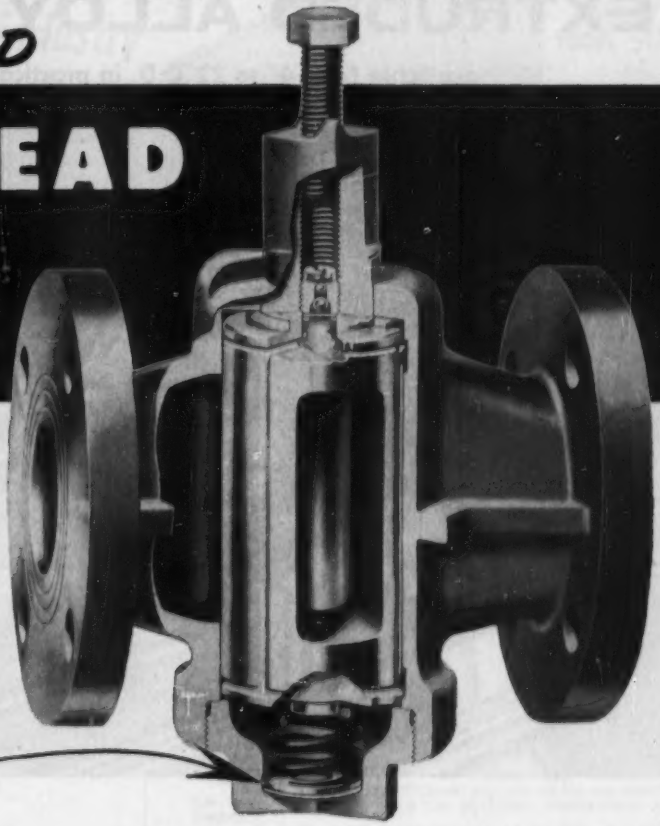

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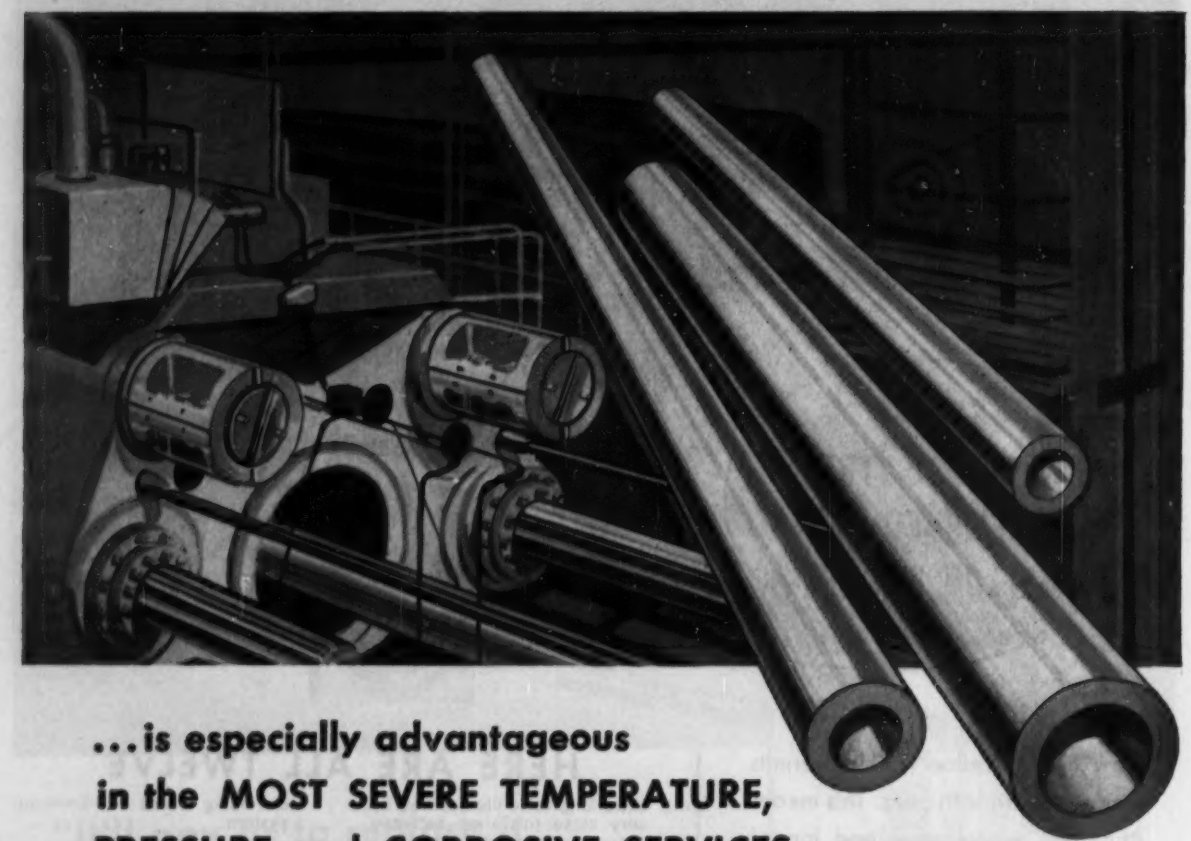

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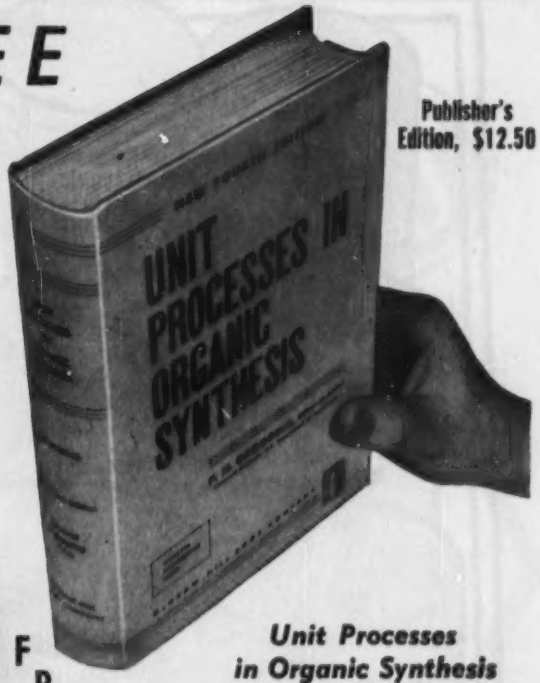

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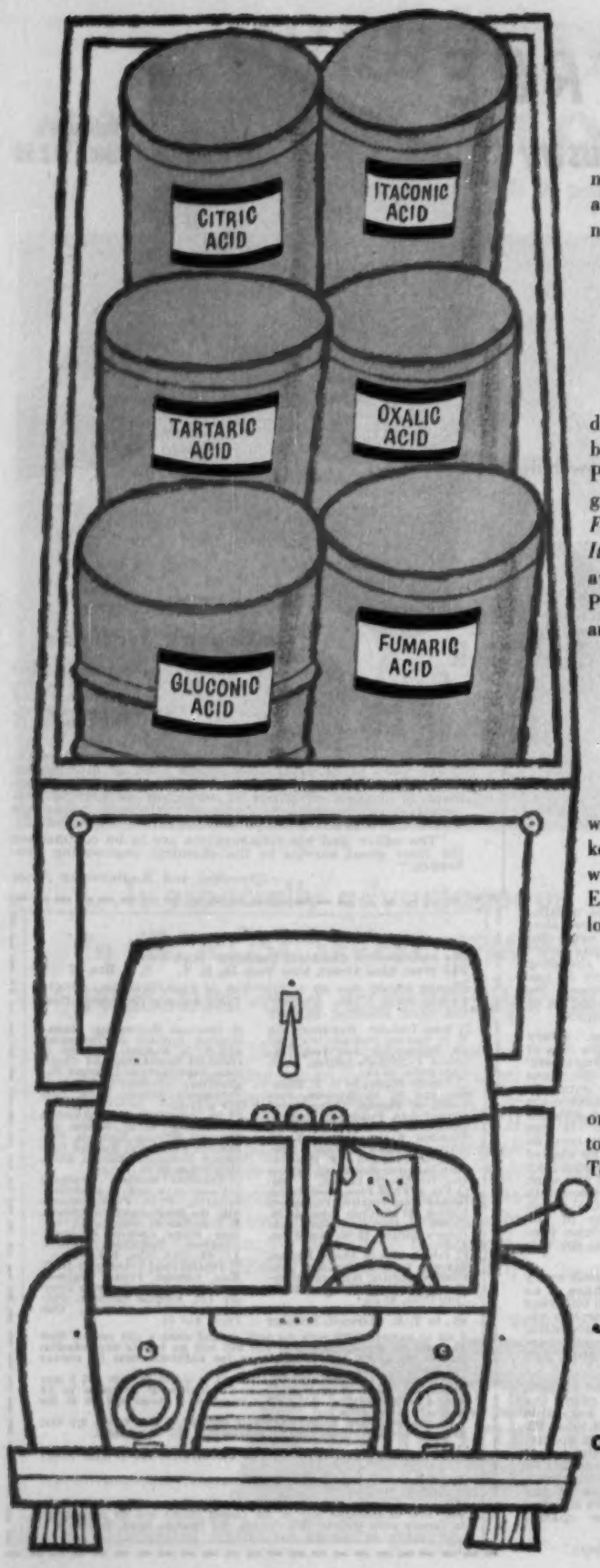

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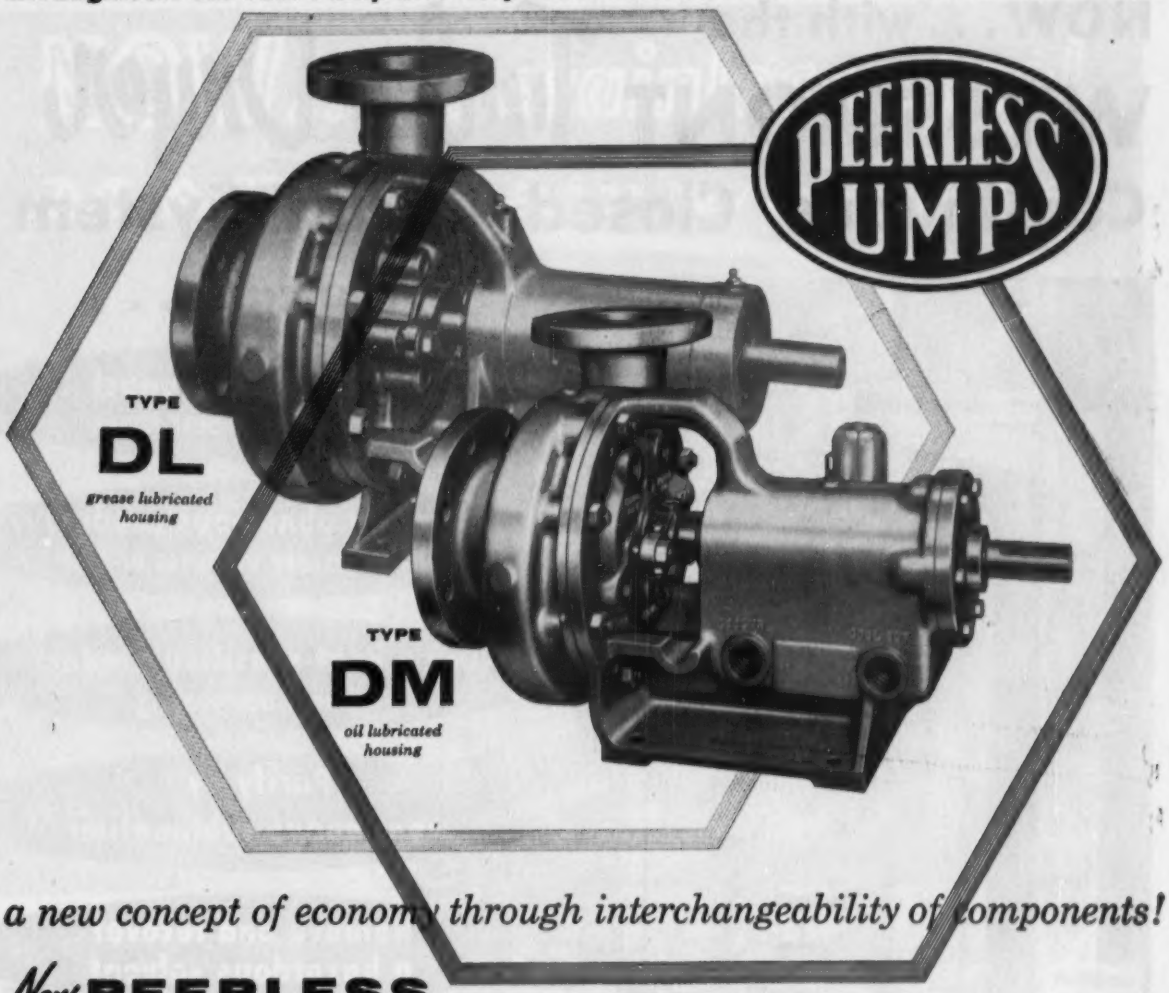

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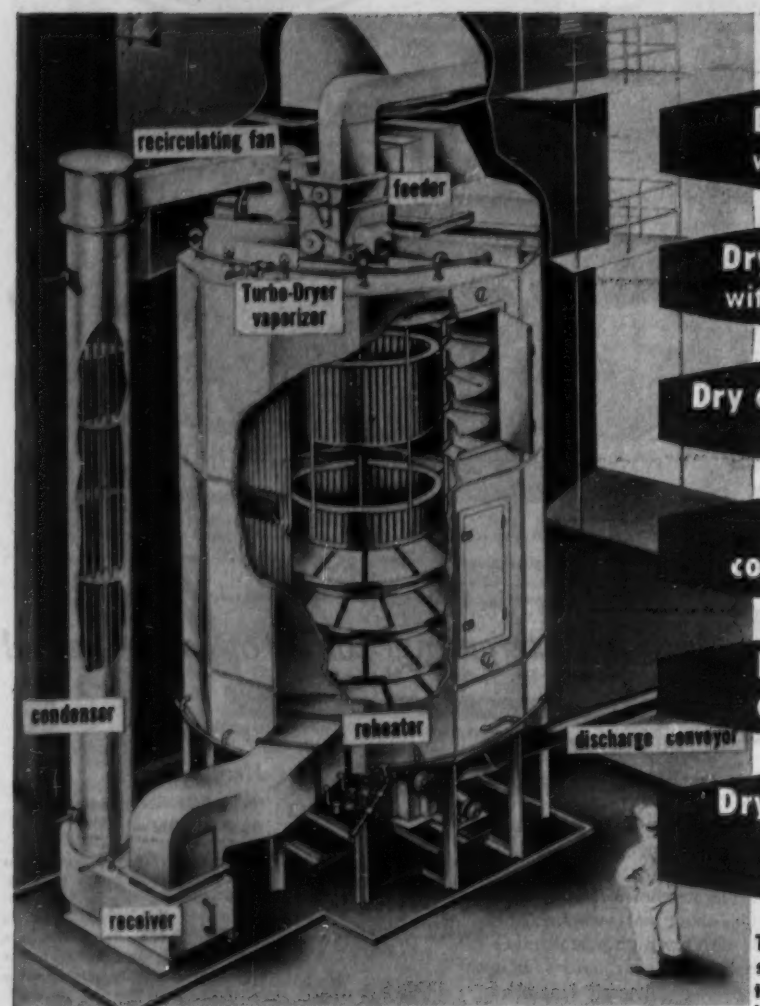

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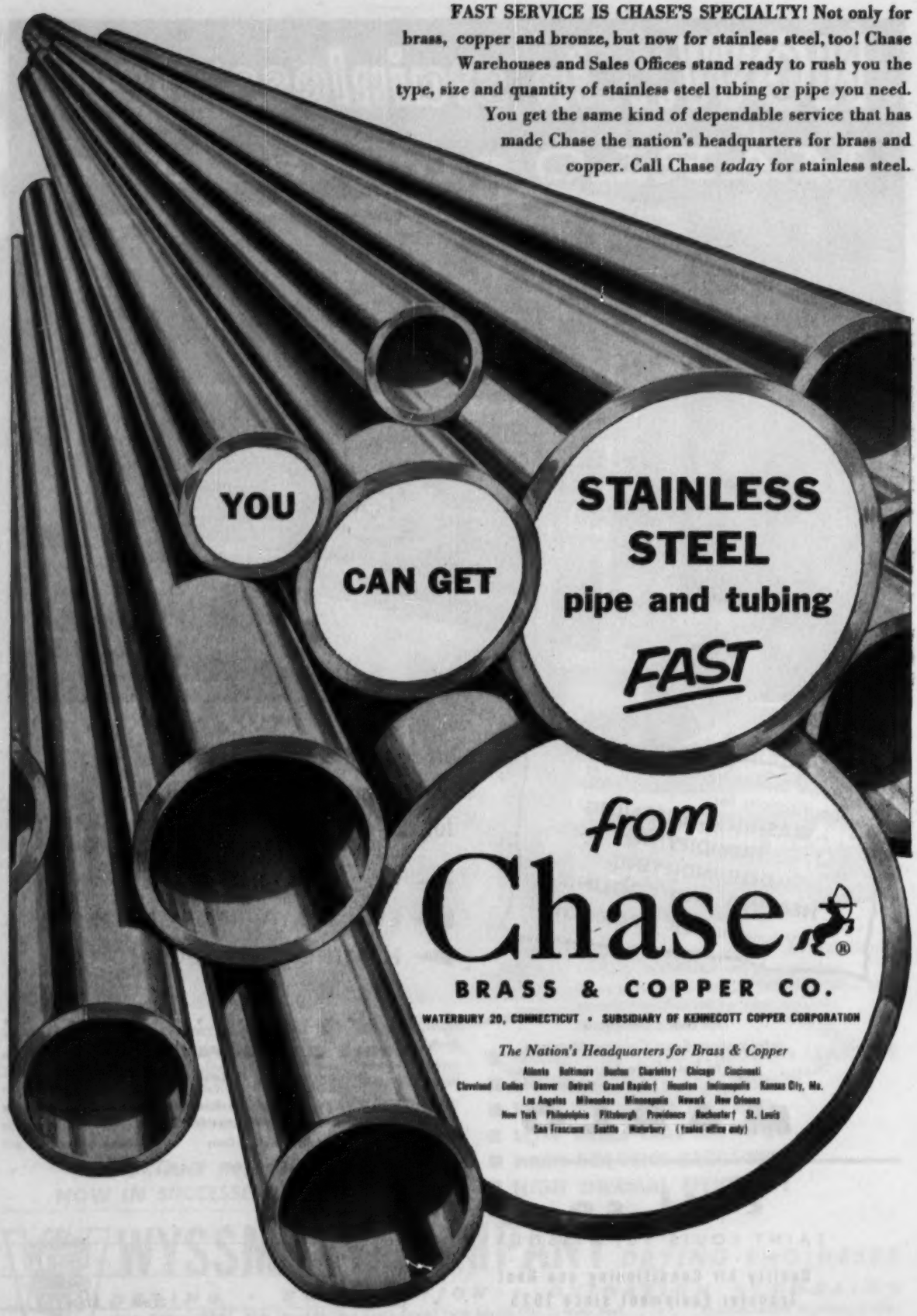
FAST SERVICE IS CHASE'S SPECIALTY! Not only for brass, copper and bronze, but now for stainless steel, too! Chase Warehouses and Sales Offices stand ready to rush you the type, size and quantity of stainless steel tubing or pipe you need. You get the same kind of dependable service that has made Chase the nation's headquarters for brass and copper. Call Chase *today* for stainless steel.
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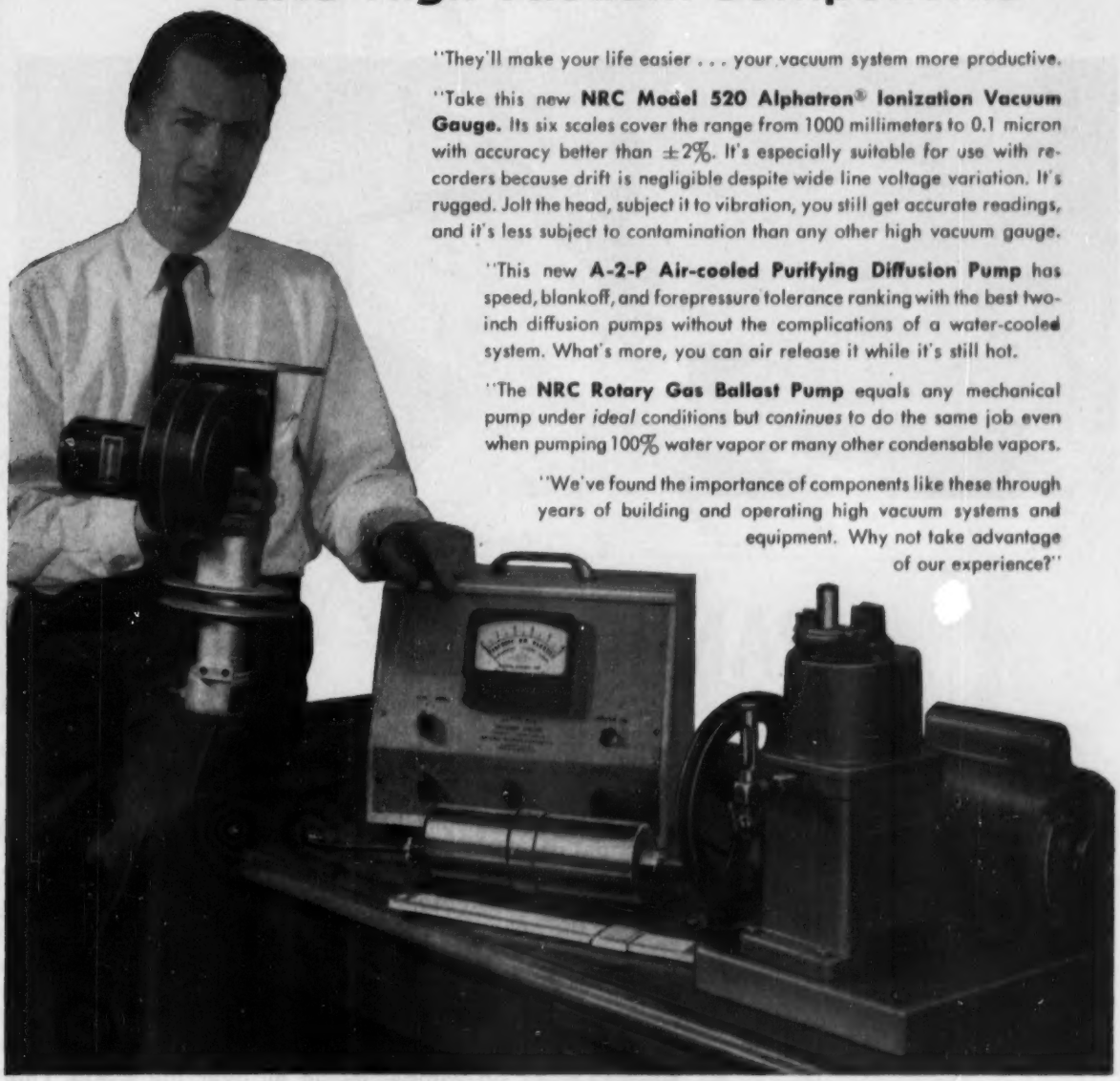
"If You've Used High Vacuum

You'll Really Appreciate These New NRC High Vacuum Components"



"They'll make your life easier . . . your vacuum system more productive.

"Take this new **NRC Model 520 Alphatron® Ionization Vacuum Gauge.** Its six scales cover the range from 1000 millimeters to 0.1 micron with accuracy better than ±2%. It's especially suitable for use with recorders because drift is negligible despite wide line voltage variation. It's rugged. Jolt the head, subject it to vibration, you still get accurate readings, and it's less subject to contamination than any other high vacuum gauge.

"This new **A-2-P Air-cooled Purifying Diffusion Pump** has speed, blankoff, and forepressure tolerance ranking with the best two-inch diffusion pumps without the complications of a water-cooled system. What's more, you can air release it while it's still hot.

"The **NRC Rotary Gas Ballast Pump** equals any mechanical pump under *ideal* conditions but *continues* to do the same job even when pumping 100% water vapor or many other condensable vapors.

"We've found the importance of components like these through years of building and operating high vacuum systems and equipment. Why not take advantage of our experience?"

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Have your representative call ☐

Name..... Title .....
Company.....
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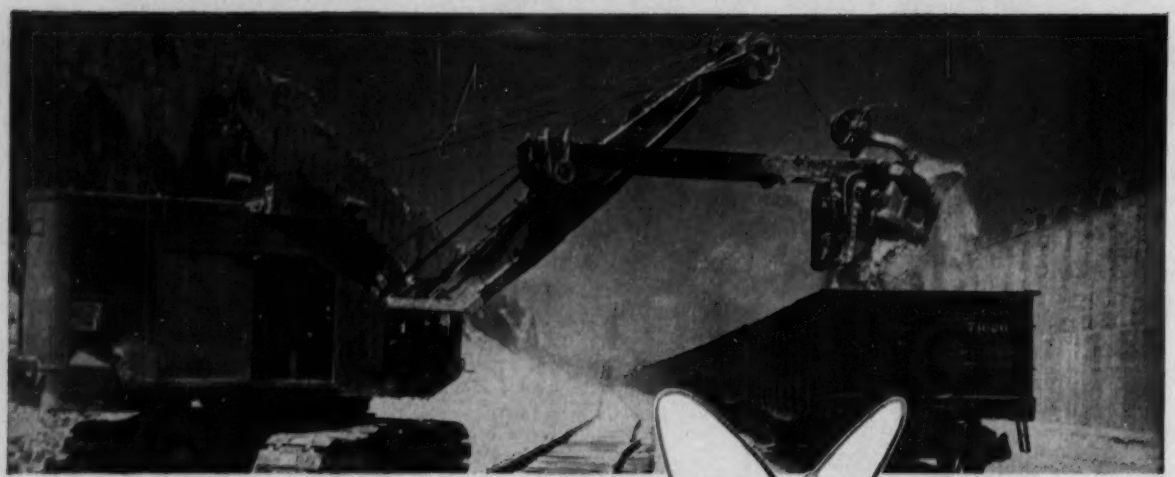
SULPHUR

helps to create

headline products



Ore milling specialists have settled upon acid leaching as the most practical and economical way to extract uranium values from ore concentrates. And as with so many other ore-leaching processes, sulphuric acid appears to be the best of the solvents, considering costs and availability.

So chalk up another 'headline' end-use for this most widely used of all acids! But this very broadening demand for sulphuric emphasizes the problem facing producers of the basic element SULPHUR. Search for new commercial sources goes on without let-up all over the world. This company is playing a leading role in this search.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

Sulphur Producing Units

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- Moss Bluff, Texas
- Spindletop, Texas
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PAYLOADER®

easiest to operate

One-lever bucket control

tips back • raises • dumps • lowers

The new-model HA "PAYLOADER" with its simple control system, smooth hydraulic brakes and full anti-friction steering mechanism is easy to operate at high output rates the full shift. Ease-of-operation is only one feature of the model HA that enables it to scoop-up, carry and deliver bulk materials faster and at less cost than heavier machines with larger engines. Other outstanding production features are the big bucket payload capacity of 18 cu. ft. (2,000 lbs.), exclusive 40° roll-back bucket action and hydraulic load shock absorber. Fork and sweeper attachments are also available for the model HA to increase its usefulness. Larger tractor-shovels in the complete, proven "PAYLOADER" line (bucket capacities up to 2¼ cu. yd. or 7,500 lbs.) give proportionately greater production. There is a nearby Distributor who would like to demonstrate the model HA or a larger "PAYLOADER" — whatever size best fits your needs.

The one-lever bucket control helped this handicapped man become one of the most-skilled, most productive "PAYLOADER" operators at a Tennessee plant.

PAYLOADER®
MANUFACTURED BY
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Send data on "PAYLOADER" tractor-shovels
- ☐ HA (18 cu. ft.) and HAH (1 cu. yd.)
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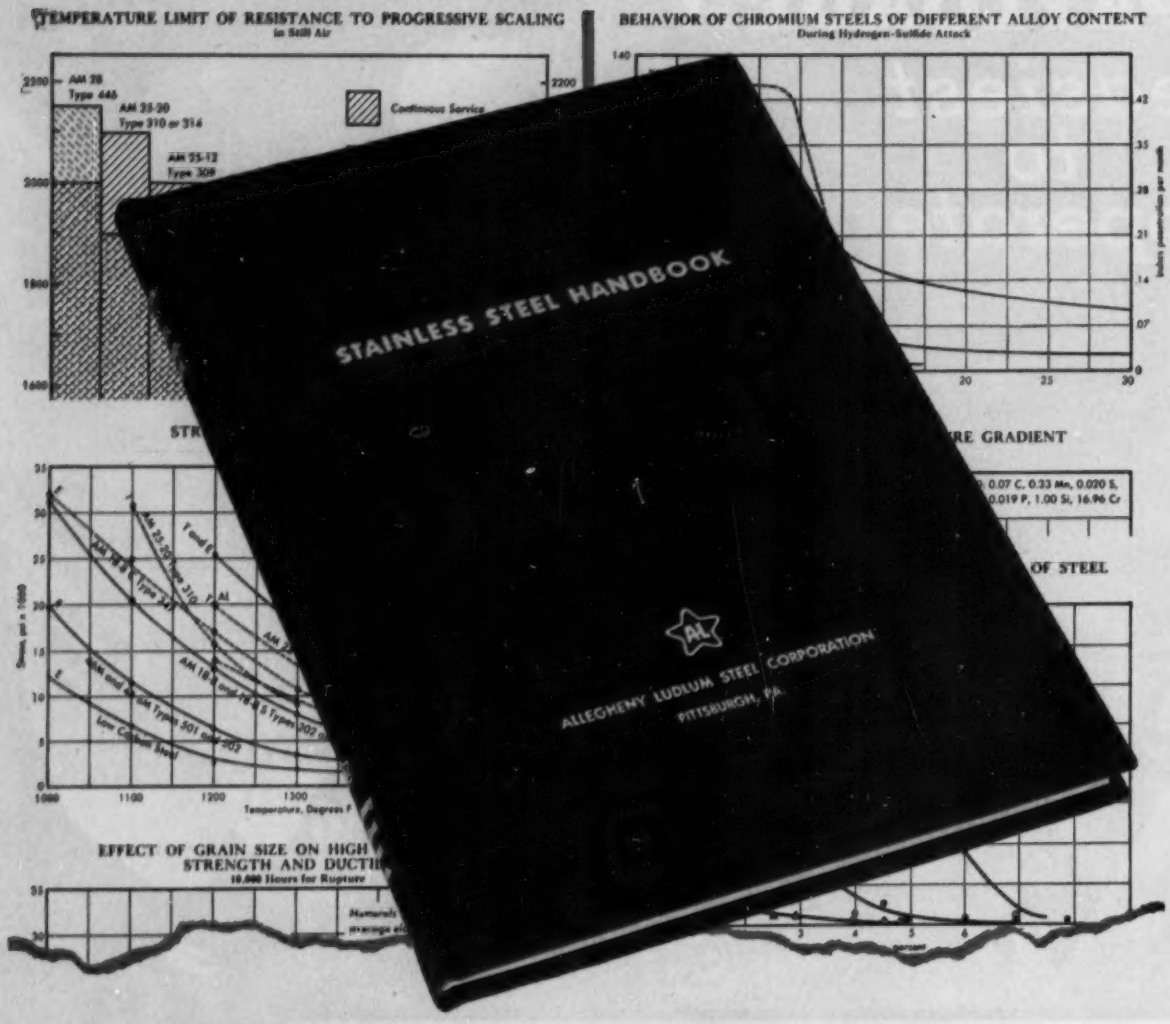

Here's 124 Pages of Valuable Data on STAINLESS STEEL

Stainless and heat resistant steel can usually be classed as a critical material, since it not only contains strategic alloys but is indispensable in many vital industrial and armament applications. It is always important, therefore, to make every pound go as far as possible.

The latest edition of our comprehensive 124-page, case-bound Stainless Steel Handbook is ready for distribution now. It will help you to select the right stainless steel and to use it properly. Comprehensive listings of analysis, properties and characteristics of each type will guide you in specifying grades that will do your job most efficiently. Clear, concise fabrication data will help you speed production and cut waste.

Your copy of the Stainless Steel Handbook will be sent—*without charge*—upon request. Our only stipulation: please make your request upon your company letterhead. ● Write *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

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For Stainless Steel in ALL Forms—call

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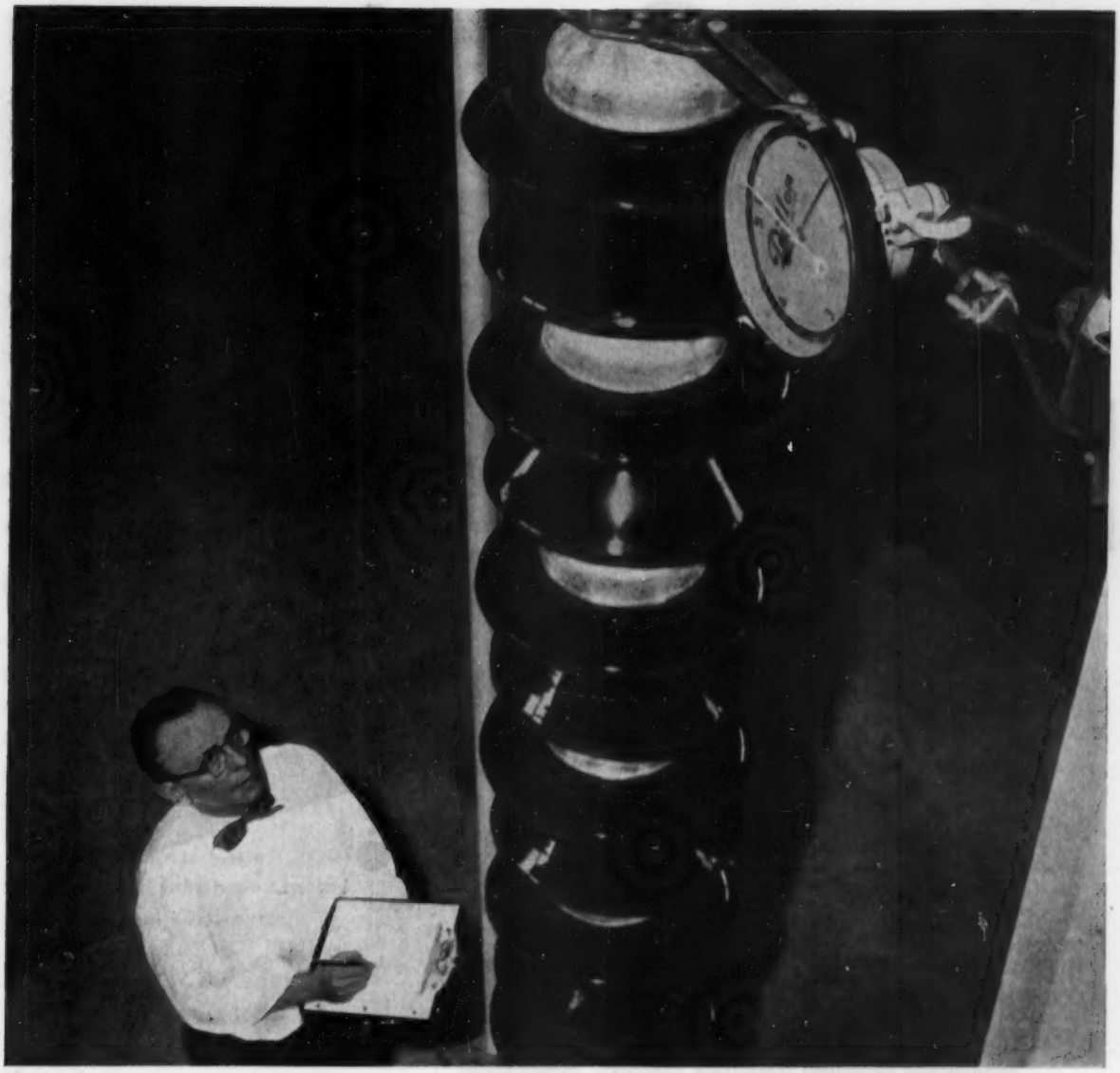
Warehouse stocks carried by all Ryerson Steel plants



How Water Conditioning helps Victor make better insulators

Big, high-voltage insulators have to be perfect. They're expensive to make. And water is an important ingredient in the clay mix and in the glazes. So, when Victor Insulator Division's research lab found that mineral salts in the water affected the quality of the porcelain, they got busy.

A Permutit ion-exchange demineralizer was installed to remove practically all mineral salts from their city water.

Results: Easier working of the clay mix which provided better dimensional control; improved thermal resistance, hardness and density; higher puncture values; better tension, torsion, cantilever and impact values. As Victor puts it, "the biggest improvement in high-voltage porcelain in 20 years."

Look again at the use of water or water solutions in *your* plant . . . for washing, plating, processing, etc. Chances are that there's an impurity you should be rid of . . . or a valuable element you want to save. In either case, ion exchange can probably take it out. We'll be glad to help you find the best method. The Permutit Company, Dept. CE-11, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®

rhymes with "compute it"

Water Conditioning
Ion Exchange • Industrial Waste Treatment

PVC Diaphragm Valves by Hills-McCanna

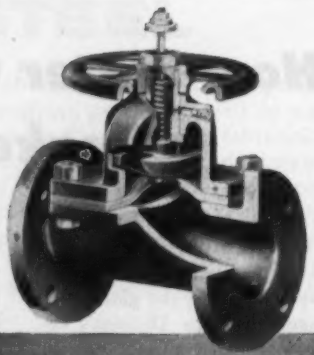
The proven partner for PVC Piping

For the finest valving in plastic piping systems—specify the valve with experience "built-in"—The Hills-McCanna Diaphragm Valve made of PVC.

ONLY Hills-McCanna *Plastic* Valves offer all these features—

- Complete chemical resistance of unmodified PVC.
- Rugged body construction with heavy wall sections and embedded reinforcing members.
- Positive valve closure with exclusive sealing bead diaphragm.
- Simple, cost-saving in-line maintenance.
- 25 years of diaphragm valve manufacturing and application experience.
- More than 10 years of research and manufacturing experience on plastic valves alone.

PVC is just one of several plastic body materials offered by Hills-McCanna. Also available are bodies of polyethylene, Saran and Uscolite. Diaphragm materials include rubber, neoprene, Hycar, Tygon, Compar, polyethylene, Kel-F and Teflon. Size range from ½" through 2". Sold and serviced by Hills-McCanna representatives coast to coast and by leading distributors of plastic pipe. For further information request Catalog No. 100.



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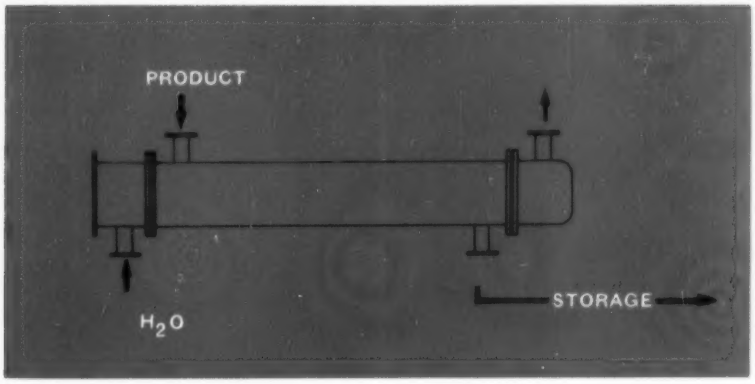
MANUFACTURERS OF: DIAPHRAGM VALVES • CHEMICAL METERING AND PROPORTIONING PUMPS • FORCE FEED LUBRICATORS • LIGHT ALLOY CASTINGS

Trufin Type S/T Boosts Cooler Capacity 50%



Secret? Integral Design

WHY TRUFIN'S EXTENDED SURFACE BOOSTS HEAT TRANSFER PERFORMANCE

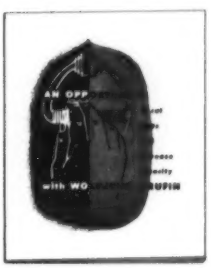
WOLVERINE TRUFIN TYPE S/T is an extended surface condenser tube. Its fins are actually extruded from the tube wall. The advantages inherent in this integral design are many.

In the first place a ¾ inch Type S/T condenser tube has an external to internal surface ratio of approximately 3½ to 1. It has approximately 2½ times as much outside surface as the plain tube it is designed to replace. It is this amazing increase in effective heat transfer surface which permits Trufin Type S/T to achieve such outstanding heat transfer performance records. And by the way that S/T is short for "shell" and "tube".

Because the fin is part of the tube it also eliminates the possibility of a loss in "Fin Joint Efficiency" regardless of temperature, thermal shock or vibration. Exhaustive pilot plant research reveals that type S/T resists fouling for longer periods than does prime surface tube.

Trufin Type S/T is available in a wide range of sizes and alloys in copper, aluminum and electric-welded steel. It can be fabricated as readily as plain tube with its integral fins giving added support on bends.

Free Book Gives Design Information



The "Trufin Opportunity Book" is available without charge from Wolverine Tube, exclusive manufacturers of Wolverine Trufin Type S/T. Compiled from actual case histories, this book contains valuable design information for operators of shell and tube heat exchange equipment.

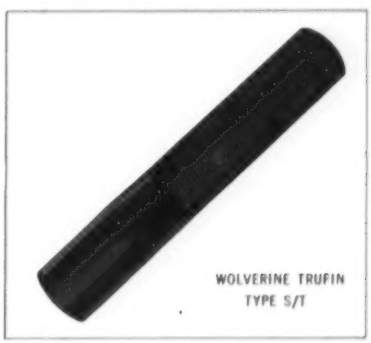
By Ernest Dodd

It's nice . . . real nice . . . when you can solve a tough problem and get yourself covered with glory – both at the same time. This is what happened to a group of refinery engineers I talked to recently, while on a field trip in the east.

These boys were faced with boosting throughput from an alcohol cooler. Here's the way in which they handled the situation.

Instead of building a completely new unit, these engineers retubed the existing prime surface tubed cooler with Wolverine Trufin Type S/T electric-welded steel condenser tube. The results were immediate—and highly gratifying.

Capacity literally zoomed – jumped a full 50%. This in itself was enough to win them a pat on the back—but there was more yet to come. In addition to increased capacity, refinery management realized considerable savings in time, materials and labor.



Retubing with Trufin Type S/T, for example, did away with the cost of tearing down old equipment and designing and installing a new and larger prime surface unit. Also eliminated was the necessity for stronger supporting members which would have been required to support a heavier unit designed around prime surface tube.

Small wonder, indeed, that management was highly pleased. The moral to this story is plain. If you want to put yourself in solid with the brass just specify Wolverine Trufin Type S/T when retubing existing equipment or having new ones designed.

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WOLVERINE TUBE

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1443 CENTRAL AVENUE, DETROIT 9, MICHIGAN
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario

Cut Condenser Tube Handling Costs

Here's a way to reduce tube handling time and costs, speed up equipment assembly, and eliminate the transportation difficulties present when handling long length condenser tubes.

Wolverine U-Bend condenser tubes are designed to achieve all these points—and more besides. Here's how:

Working to your specifications Wolverine prefabricates U-Bend condenser tubes and packages them on disposable pallets—*in the exact order of installation.*

All you have to do is feed the tubes directly from the pallet into the unit. Think of the convenience this can bring to your operation particularly when handling tubes over 30 feet in length. In addition, Wolverine U-Bends also cut rolling-in operations in half, eliminate one tube sheet and make floating head problems a thing of the past.

Wolverine U-Bends are available in a wide range of sizes and alloys in copper, aluminum and electric-welded steel. They may be specified in prime surface form or with integral fins (Wolverine Trufin) for increased heat transfer surface.

Next time you place an order for condenser tubes—specify Wolverine U-Bends—reap the immediate benefits these prefabricated tubes can give. For complete information write for Wolverine's Condenser Tube Catalog.

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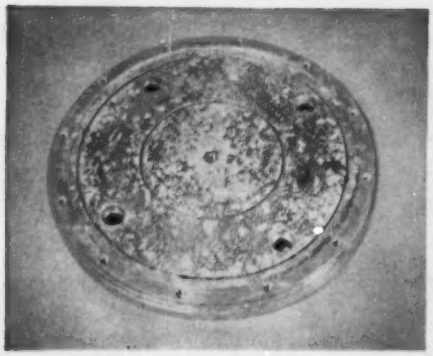
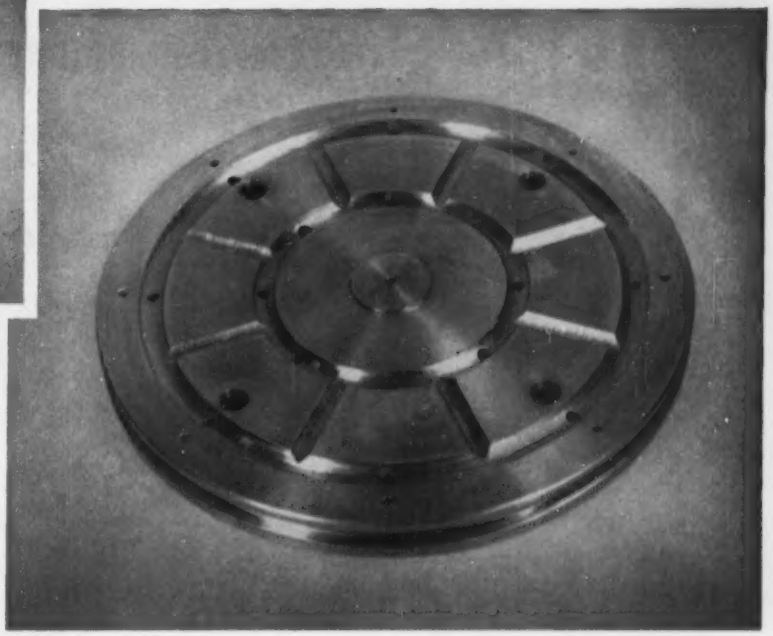


CORROSION-RESISTANT COMPONENT of filter press unit is severely pitted from chloride ion attack of calcium hypochlorite in just 2 weeks.

TITANIUM COMPONENT of filter press is clean, uncorroded after 7 months' exposure to calcium hypochlorite solution.



Titanium Filter Press Resists Attack of Corrosive Bleach

Pennsalt titanium unit shows no sign of chloride pitting after seven months' use

At Pennsylvania Salt Manufacturing Co., titanium is used for contact parts of the filter press employed in making solid cakes of calcium hypochlorite from corrosive slurries for hypochlorite bleach. Here the problem was to find a construction material for the unit able to withstand the highly corrosive effects of strong hypochlorite solutions. Corrosion-resistant components, ordinarily used, developed severe pitting corrosion from chloride ion attack in a matter of weeks.

After testing many metals, titanium was selected and adapted to equipment used in the most critical operations. The titanium unit at Pennsalt has been in operation for seven months and it still shows no sign of corrosion. Tool markings left by machining operations are still clearly visible on titanium parts.

Titanium again solves a corrosion problem by extending the life of essential equipment. If severe corrosion is *your* problem, titanium may be the answer.

DU PONT CAN HELP YOU START YOUR EVALUATION TESTS NOW

As a pioneer in the commercial production of titanium sponge and development of industrial applications of titanium, Du Pont can offer you expert technical help. And Du Pont can put you in touch with manufacturers best equipped to work along with you. Considerable fabricating know-how and a wide variety of mill shapes are *now* available to help solve your corrosion problems. For more detailed information on titanium, just check coupon below.

E. I. du Pont de Nemours & Co. (Inc.)
Pigments Department CE-11
Wilmington 98, Delaware

☐ Please send me your new technical bulletin on the corrosion-resistant properties of titanium.

☐ Please send me your general booklet on titanium.

I am interested in using titanium for:_____

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*Firm*_____ *Position*_____

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TITANIUM SPONGE

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DU PONT
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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

There's more to filtration than

$$\frac{dV}{Ad\theta} = \frac{\mathcal{E}c \times \Delta p}{(\alpha W/A + Rm)\mu}$$

Photo courtesy T. Shriver & Co.

Filtrate volume, pressure drop, cake weight, viscosity—these are a few of the variables in this basic equation for cake filtration. None of these factors can be ignored, any more than the many variables can be overlooked in the selection of a filter fabric. Fiber, yarn number, crimp, twist, weave, porosity and other qualities must be calculated and considered before a filter fabric can be selected for a specific filtration job. That's why you should make fullest possible use of the people who engineer and distribute filter fabrics.

If you have a particularly knotty filtration problem, call us. A wide range of cotton and synthetic fabrics in many constructions is available for your requirements. Make use of Wellington Sears' century of experience in industrial fabrics, and the practical knowledge of our specialist-distributors. We are all ready to serve you. For free copy of illustrated booklet, "Filter Fabric Facts," write Dept. L-11.

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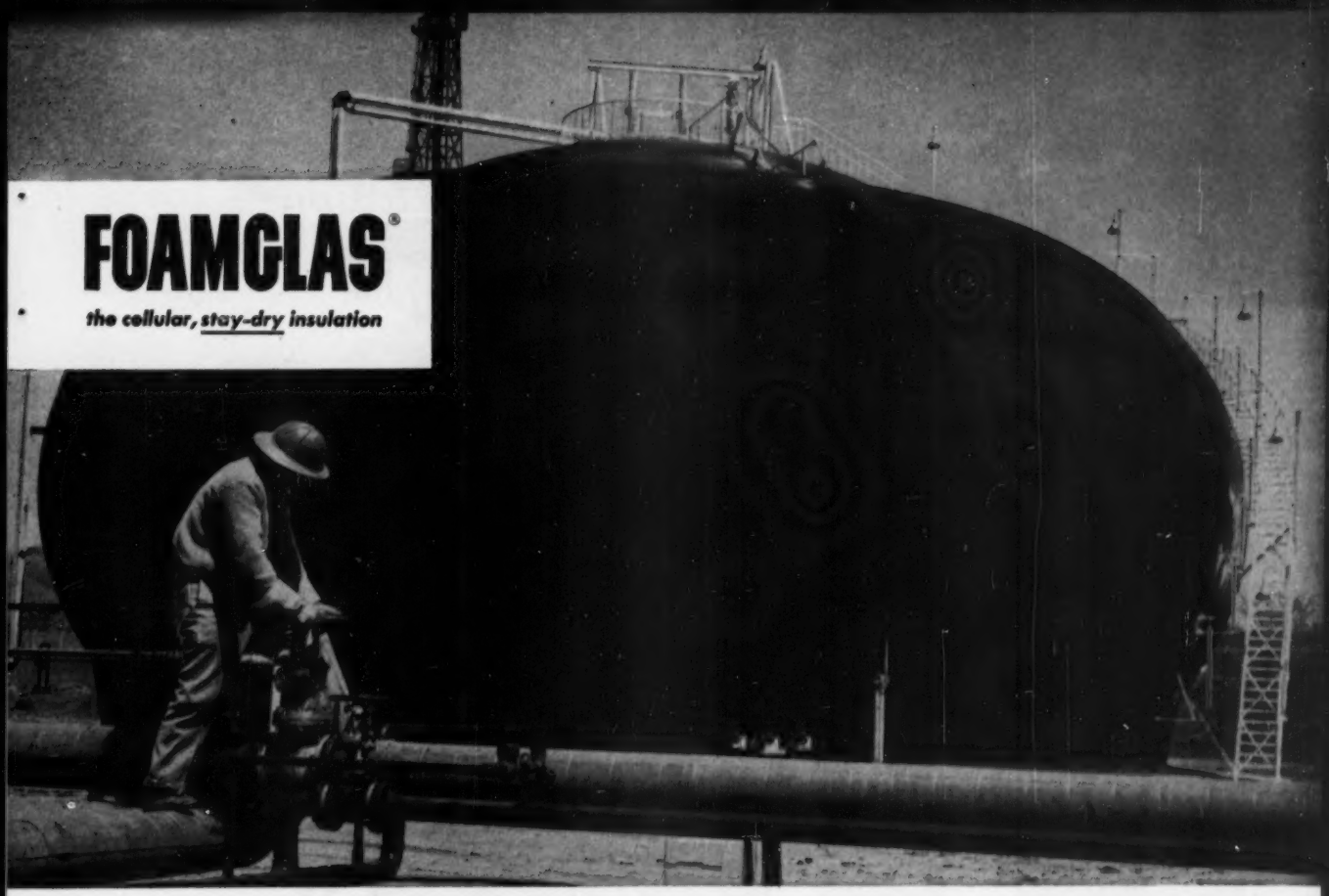


Gulf accurately controls the temperature of stored butane and cuts corrosion of tanks and piping . . . because FOAMGLAS insulation is moisture-proof. Excellent FOAMGLAS performance on earlier Gulf insulating jobs led to its use here, at their Cleves, Ohio, refinery. Similar installations are now underway at the company's Philadelphia refinery.

Gulf controls temperature and corrosion with moisture-proof FOAMGLAS insulating tanks and piping

Gulf Oil Corporation adds butane to Gulf gasoline for quick cold weather starting. And Gulf picked moisture-proof FOAMGLAS to insulate two 40,000 bbl butane storage tanks and fill lines at their Cleves, Ohio, refinery. Gulf had to get accurate butane temperature-pressure control and at the same time cut corrosion on tanks and lines.

Here's why they picked FOAMGLAS. This unique insulation is an inorganic, all-glass material composed of millions of sealed glass cells, each a tiny dead air insulating space. Since the cells are sealed, moisture cannot penetrate them to reduce or destroy insulating value. Gulf gets the constant insulating effectiveness needed to hold butane in a liquid state the year round at a temperature and pressure of 50°F and 10 psi.

Since FOAMGLAS is also a highly effective vapor barrier, it gives Gulf added corrosion protection. Moisture cannot penetrate the insulation which is adhered with mastic and thus cannot attack tank walls and piping.

Because it cannot burn, FOAMGLAS even helps to reduce fire hazards in handling such volatile fluids as butane. And neither acid atmospheres nor spillage can harm this inorganic material.

Whatever *your* tank, piping or equipment insulation problem, you'll solve it best with FOAMGLAS. Six simple "desk top tests," quickly performed on a FOAMGLAS sample in your own office, will convince you. Send for a sample and complete testing directions today. Address . . .

Pittsburgh Corning Corporation
Dept. H-126, One Gateway Center
Pittsburgh 22, Pennsylvania
In Canada: 57 Bloor St. W., Toronto, Ontario

PC® Also manufacturers of PC Glass Blocks

At Gulf's refinery, Cleves, Ohio, FOAMGLAS blocks were installed on large butane storage tanks by impaling the blocks on steel studs welded to the tank surface. The ease of cutting and shaping FOAMGLAS enabled workers to do the job quickly and easily. Clips were then fastened to stud ends, and glass fabric, asphalt cutback and aluminum paint completed the installation. Insulation Contractor: Geo. V. Hamilton, Inc., McKees Rocks, Pa.

5 STEPS

in making an almost indestructible turbine

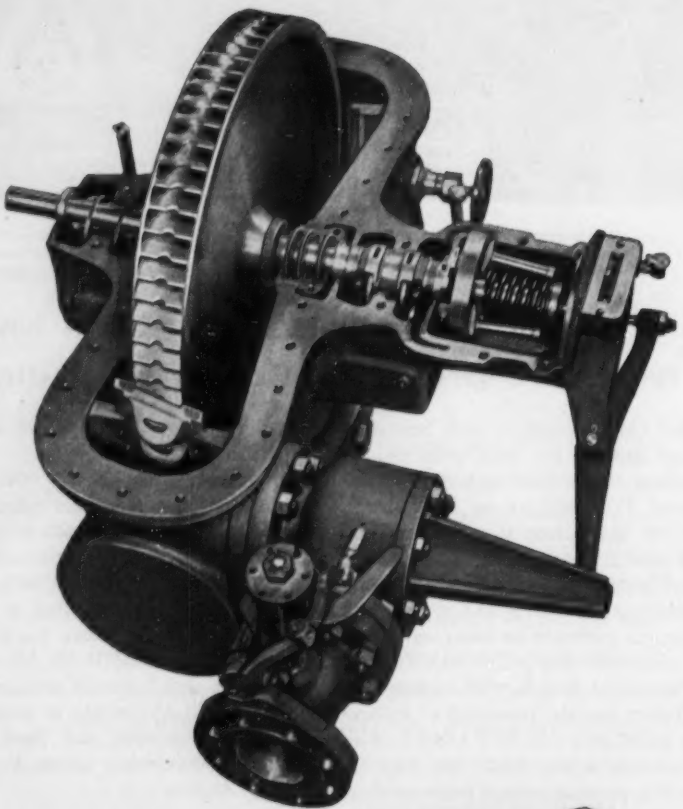
The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

The Terry solid-wheel turbine is an extremely reliable piece of equipment. Write for details—today. Ask for a copy of bulletin S-116.

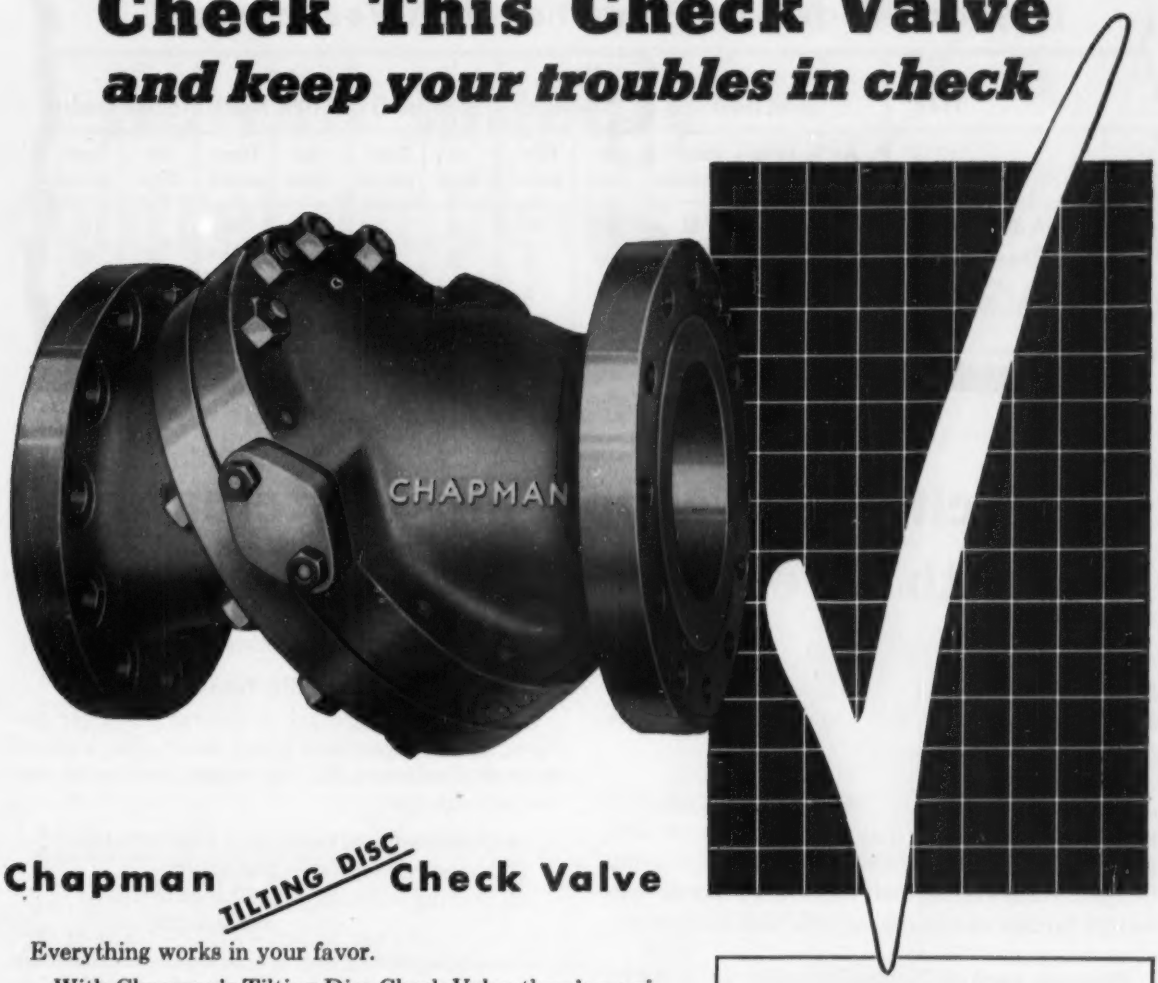
THE
TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.



TERRY

TT-1204

Check This Check Valve
and keep your troubles in check



Chapman TILTING DISC Check Valve

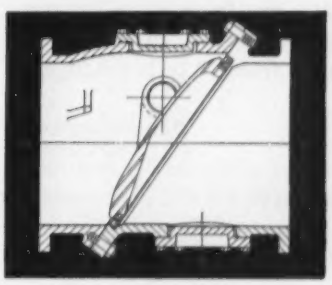
Everything works in your favor.

With Chapman's Tilting Disc Check Valve there's no vibration, no fluttering, no noise. There's no slamming, with usual piping arrangements, no banging to cause damage to system or valve. There's no grinding, scraping or wearing to either the disc or seat.

All of this means less headaches to you . . . both physical and financial headaches. The smooth, sure, quiet action means less, much less, maintenance over the longest period under toughest operating conditions.

Chapman Tilting Disc Check Valves with money-saving advantages like these are available in iron and steel, with standard end to end, for handling fluids or gases under a wide range of pressures. They're listed and shown in our Catalog 30-A. Send for it and check the valves you need for replacement or new piping systems, right now.

The CHAPMAN Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS



The Valve That Goes with the Flow

Here's the idea in back of it all. When the flow is on, "airfoil" disc is held firmly against stops in the body. When the flow drops, disc balances itself quietly on whatever flow there is. When the flow stops, disc drops quickly and tightly on special bevel seat. It's as simple as that. It's as sound as that. And valve men will be pleased when they see that enough room is given around disc to cut down flow resistance.

Typical Mechanical Properties of Ni-Vee Bronzes

TYPE	A (lead free)			B (1% lead		C (5% lead)		D (10% lead)		E (20% lead)	
	As Cast	Tempered	Heat-Treated	As Cast	Tempered	As Cast	Tempered	As Cast	Tempered	As Cast	Tempered
Tensile Strength (thousand psi)	50	65	85	45	60	40	50	35	40	25	30
Yield Strength (thousand psi)	22	40	55	20	30	20	30	20	25	18	22
Elongation, % in 2"	40	10	10	30	8	15	5	10	2	5	2
Brinell Hardness	85	130	180	80	120	80	130	80	110	70	80

Specifying is simple and systematic with 5 versatile Ni-Vee Bronzes

Now . . . designers and engineers can readily select a suitable bronze for any specific need . . . from only five Ni-Vee* bronzes.

"As Cast," these five Ni-Vee bronzes provide mechanical properties that surpass those of comparable G bronze, red brasses and leaded bearing bronzes. What's more, their superior properties can be still further elevated by simple heat-treatments.

Basically, each Ni-Vee bronze contains 5% nickel and 5% tin, from 0 up to 20% of lead. Tensile strength ranges from 25 to 85 thousand psi, and hardness from 70 to 180 Brinell.

Advantages

Just five of these Ni-Vee bronzes make it possible to standardize metal inventories, melting practices and shop operation . . . as well as specification . . . to meet many industrial uses for copper-base castings.

Each Ni-Vee bronze contains an optimum nickel content to raise levels of strength, hardness and toughness. In addition, this nickel content provides a high degree of corrosion resistance in the Ni-Vee bronzes. Negligible zinc content makes it free from dezincification. This spells resistance to stress-corrosion attack.

A versatile family

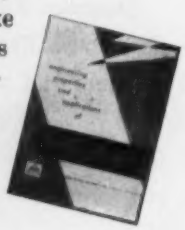
Copper-base alloys are ordinarily used for the three types of castings listed below. For each of these applications a Ni-Vee bronze provides particular advantages:

(1) **Constructional** castings – high strength
(2) **Pressure** castings – fine grain
(3) **Bearing** castings – resistance to wear and seizure

The simple family of five Ni-Vee bronzes actually replaces the confusing variety of miscellaneous bronzes. As a result, engineers and designers can now specify simply and systematically . . . specify Ni-Vee bronzes wherever possible. Parts cast in Ni-Vee bronze already serve *electrical, power, steel, petroleum, chemical, automotive, aircraft, railroad and other industries.*

Engineering data for you

Learn how the Ni-Vee bronzes can simplify your specification work, improve product performance. Send for a copy of *"Engineering Properties and Applications of Ni-Vee Bronzes."* It contains useful information like that given in the table above: tables of composition, charts on deformation, friction, fatigue, elevated temperature service, electrical resistivity, wear and other engineering data. *Write for it now.*



*Registered trademark

INCO NICKEL

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N.Y.

How to simplify control problems

Keep systems flexible, carry small inventory, cut maintenance cost with the **Bailey Building Block Method** of instrumentation and control.

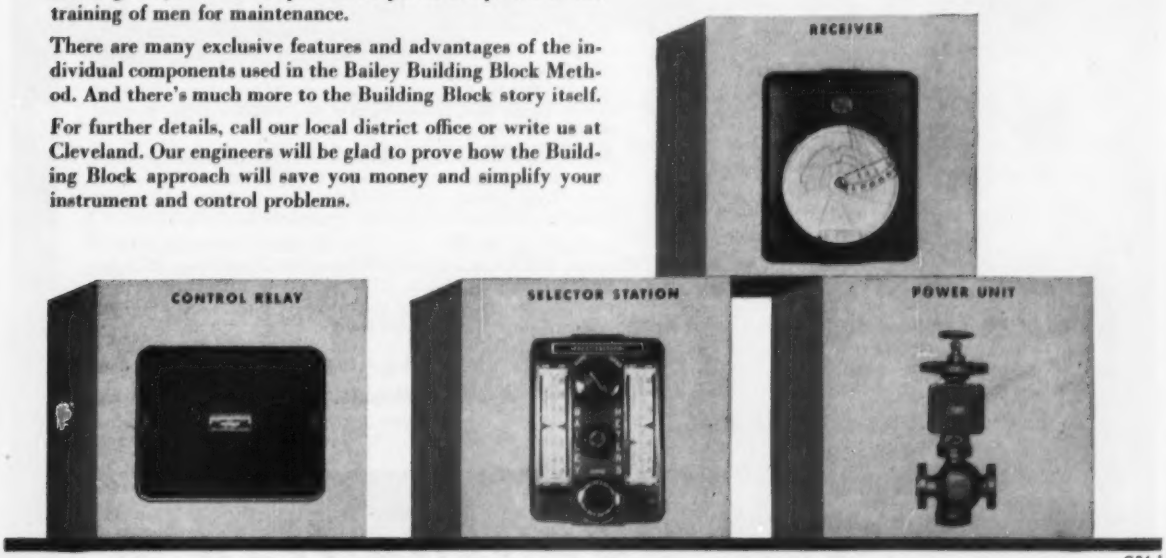
What is the Bailey Building Block Method? It's using standardized Bailey measuring, transmitting, and controlling components and combining them into any system you need. Components can be added as needed . . . removed and reused elsewhere . . . recombined into another system when the need changes. It's flexibility plus!

It's all based on the simple fact that a Bailey instrument or control component doesn't care if the measured variable is steam flow, tank level, or tower temperature, to pick just three examples. System components—transmitters, receivers, relays, selector stations, power units—are standardized for multi-purpose use.

A spare component can be used in any one of many systems. Gone are delays waiting for shipments of special parts. Gone are large inventories of spares and parts. Simplified is the training of men for maintenance.

There are many exclusive features and advantages of the individual components used in the Bailey Building Block Method. And there's much more to the Building Block story itself.

For further details, call our local district office or write us at Cleveland. Our engineers will be glad to prove how the Building Block approach will save you money and simplify your instrument and control problems.



G36-1

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RESULTS IN: FLEXIBILITY, SIMPLICITY, ECONOMY

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Carpenter Stainless No. 20 controls flow of liquid oxygen, red fuming nitric acid

Vital parts of these flow sensing units must have extreme corrosion resistance and durability. Machined from Carpenter Stainless No. 20 bar stock, they measure the flow of liquid oxygen and red fuming nitric acid (90-98% concentration). The No. 20 parts have outlasted two Type 316 housings. The units are so rugged that rocket experts recover them from wrecked missiles for re-use.

Similar units also measure the flow of oil to industrial furnaces, gases, slurries and other corrosive fluids at rates of .09 to 3000 gpm. They operate from 1000°F down to temperatures approaching absolute zero, and at pressures up to 35,000 psi.

If you design, build or use equipment that must withstand corrosive attack, discover how Stainless No. 20 and No. 20Cb can save you money. Eight different forms—bars, billets, pipe, plate, sheet, strip, tubing and wire—of these super-corrosion resistant alloys are available from . . .

MEMBER

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

Carpenter

Stainless No. 20

Carpenter No. 20 bars, strip, wire and billets are available also from The Carpenter Steel Company, Reading, Pa.

Ad #1-57

Space Requirements

cut 50%

ALLIS-CHALMERS
Stainless Steel
GYRATORY SCREEN

Eight Allis-Chalmers Units Do Same Job Formerly Done by Sixteen Electro-Magnetic Screens in Large Chemical Plant

IN THIS installation — as in most plants where screening is done — two factors make this remarkable achievement possible. (1) The stacked-deck design of the Allis-Chalmers stainless steel gyratory screen provides up to 35 square feet of screening area in just 16 feet of floor space. (2) The gentle but thorough gyratory action provides maximum capacity by exposing product to entire screening area.

Noise Level Greatly Reduced — The comparative quietness of the Allis-Chalmers gyratory screens was apparent as soon as they were installed. In these units, a dynamically balanced mechanism assures quiet, vibrationless performance. Operating economy (low power requirement) was another advantage gained in the change to A-C screens.

Improved Quality Control — In addition to top screening efficiency and economy, this newest and finest of mechanical screens is built to give you profit-insuring quality control and quick, sanitary, simplified maintenance. Get the complete story. Contact your nearby Allis-Chalmers representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. Ask for Bulletin 07B8446.

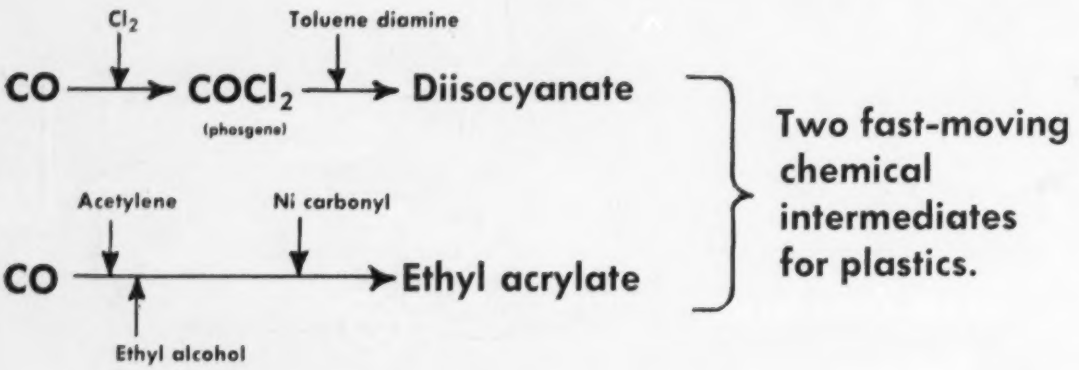
A-C ALLIS-CHALMERS

Pictured Flowsheet

EDITED BY R. B. NORDEN

Natural Gas and Steam

CO: Up and Coming Raw Material



Tied in closely with the boom in isocyanate and acrylate production, carbon monoxide—long the bane of many chemical processes—is taking on the role of an important and fast-moving raw material.

Right now large units are in operation in four locations for the generation of high-purity CO:*

• National Aniline at Moundsville, W. Va., produces CO in a brand-new unit engineered by Girdler. Carbon monoxide reacts with chlorine, forming phosgene ($COCl_2$); and toluene diisocyanates form from the reaction between toluene amine and phosgene—TDI is an important ingredient in the manufacture of urethane plastics (see CE, Sept. 1955, p. 112). Present production capacity for isocyanates is estimated at 8 million lb./yr.

• Du Pont, at Deepwater, N. J., has a new Du Pont-designed unit supplying enough CO for a stated isocyanate capacity of 25 million lb./yr.

• Mobay (jointly owned by Monsanto and Farbenfabriken Bayer) at New Martinsville, W. Va., also produces isocyanates via CO and phosgene. The CO unit is a "German design." Present estimated capacity for isocyanates: 12 million lb./yr., which will be tripled when new expansion plans are translated into process equipment.

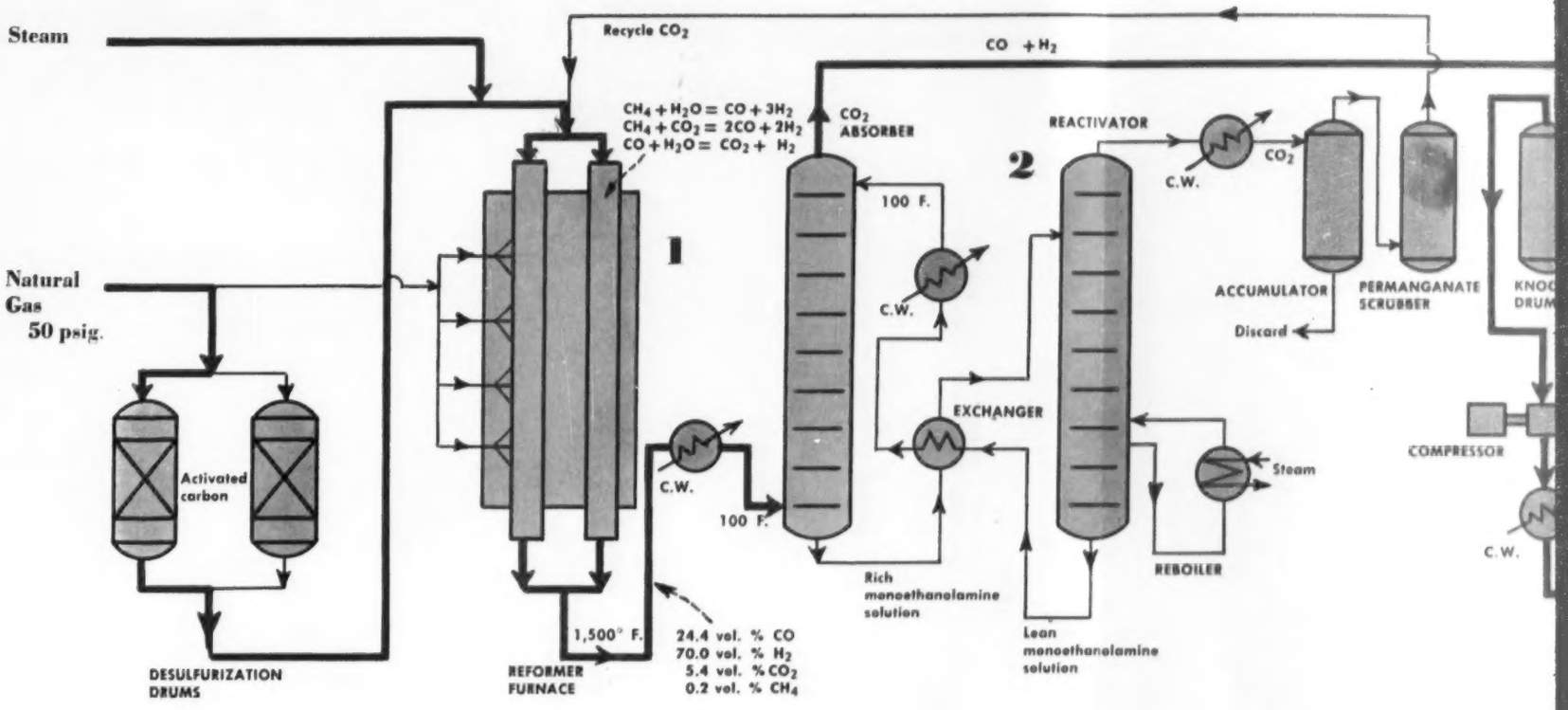
Over-all isocyanate production is lagging behind capacity now, but by the end of 1958 it's expected that demand will equal a total U. S. capacity near the 70 million lb./yr. mark.

• Rohm & Haas at Houston, Texas, produces CO in a Girdler unit and makes acrylates. Here CO reacts with acetylene and ethyl alcohol over a nickel carbonyl catalyst to produce ethyl acrylate monomer—an important ingredient in plastics, rubber, water-based paints. Rohm & Haas is now expanding acrylate capacity at Houston.

All four companies produce CO by a similar process: Steam reforming of natural gas, then removal of CO_2 by absorption in an amine solution, followed by caustic scrubbing, compression, and separation of CO and H_2 in a low temperature unit.

▶ **Process Scheme**—In a typical continuous process (see flowsheet) natural gas first passes through a desulfurization drum where organic sulfur is removed (sulfur poisons the nickel catalyst used in the reforming step). The gas then mixes with steam and recycle CO_2 and passes over the nickel catalyst contained in vertical alloy tubes suspended in a combustion chamber. Temperature in the catalyst bed is around

* This should be distinguished from production of a mixture of CO and H_2 (synthesis gas)—produced by partial oxidation or steam reforming of natural gas. Synthesis gas is used in Fischer-Tropsch and Oxo reactions, and as a source of H_2 in synthetic ammonia production.



1,500 F. The reactions that occur in the furnace are:

$CH_4 + H_2O = CO + 3\ H_2$
$CH_4 + CO_2 = 2CO + 2\ H_2$
$CO + H_2O = CO_2 + H_2$

Furnace effluent composition depends on the equilibrium position of the third reaction at exit temperature. Recycle CO_2 helps shift the equilibrium in favor of a higher CO yield. A typical furnace effluent composition on a dry basis would be: 24.4 vol.% CO, 70.0% H_2, 5.4% CO_2 and 0.2% CH_4.

Furnace effluent, cooled to around 900 F. by direct quench, then to 100 F. in a shell-and-tube exchanger, enters the carbon dioxide removal unit, based on a 15 or 20 weight % monoethanolamine (MEA) solution.

▶**Purifying Synthesis Gas**—Here MEA (100 F.) flows countercurrent to the gas in an absorption column fitted with bubble-cap trays. Rich MEA solution (containing most of the CO_2) comes off the bottom of the tower, picks up some heat from the regenerated MEA, then goes into the reactivator column.

Carbon dioxide is stripped from the rich solution with steam heat—it is regenerated at sufficient pressure so that the released CO_2 is recycled to the reformer furnace without a compression step.

▶**Low Temperature Separation**—Synthesis gas now contains less than 0.05% CO_2. Before entering the low temperature unit, it mixes with recycle hydrogen. Then it's compressed to 400 psig., and scrubbed with a 10% caustic solution to remove last traces of CO_2, which would freeze out in the low temperature equipment. After cooling, traces of water vapor are removed in a solid dessicant (activated alumina) absorber.

Synthesis gas then goes into the low-temperature exchanger (warm) where it's cooled by the outgoing streams—hydrogen, CO and recycle.

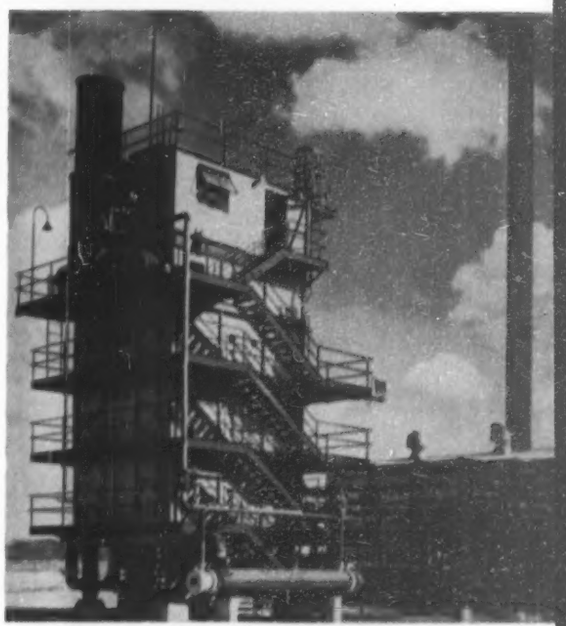
Hydrogen separates from CO in a double fractionating column. Actually a first separation is carried out in the high-pressure part of the column (400 psig.), around −330 F. Overhead is practically pure H_2.

Bottom product flashes as feed to the low pressure column (4 psig.). Pure CO comes out of the top of this column, and a side stream of methane is taken off the bottom.

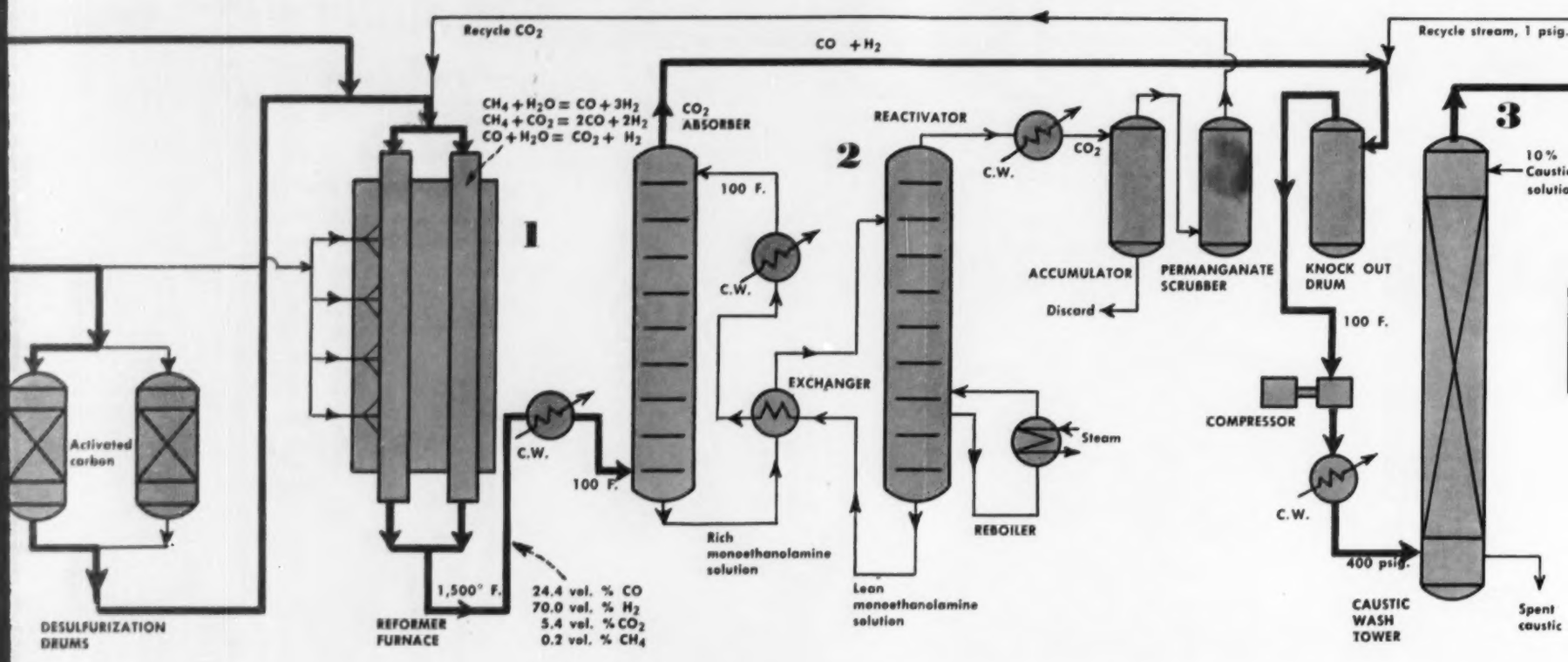
Typical product purity: 98.6 vol.% CO, 1.2% H_2, 0.2% CH_4. Typical byproduct H_2 purity: 97.3% H_2, 2.7% CO.

Raw materials and utilities to produce 1,000 scf. (60 F. and 14.7 psia.) of high-purity CO (100% basis) from a typical natural gas:

Natural gas	1940 scf.
Steam (75 psig.)	265 lb.
Electric power	26 kwh.
Cooling water	2415 gal.
MEA	0.01 lb.
Caustic	0.3 lb.



1 REFORMER FURNACE, where natural gas reacts wi steam over a nickel catalyst to produce CO, CO_2 and H



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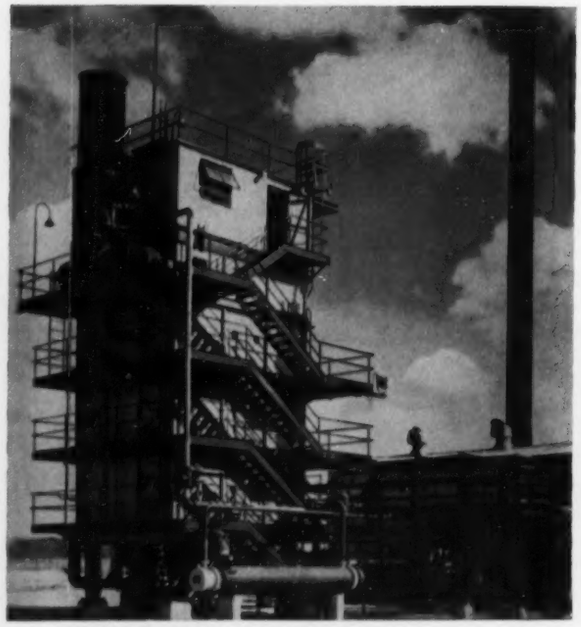
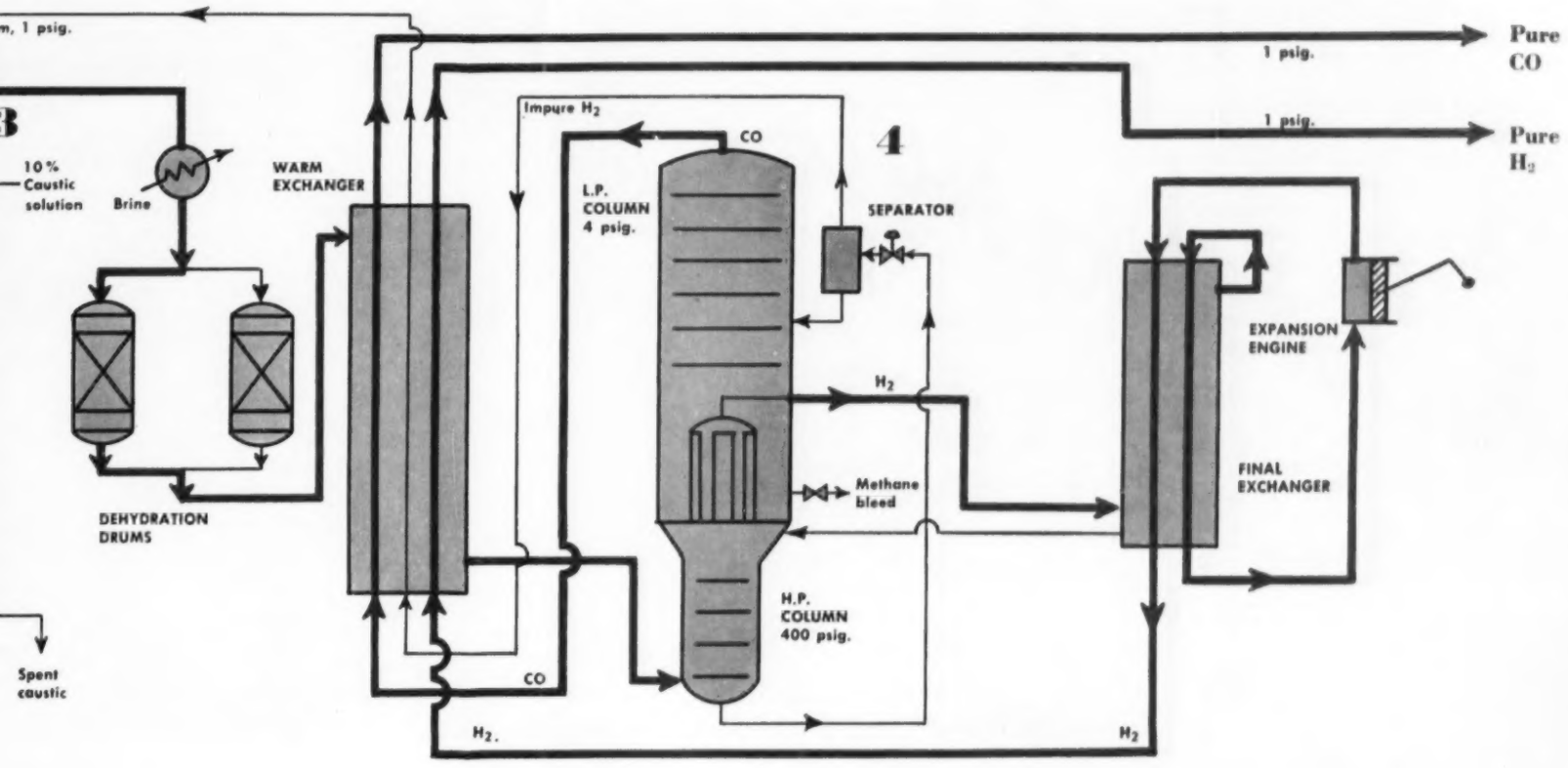
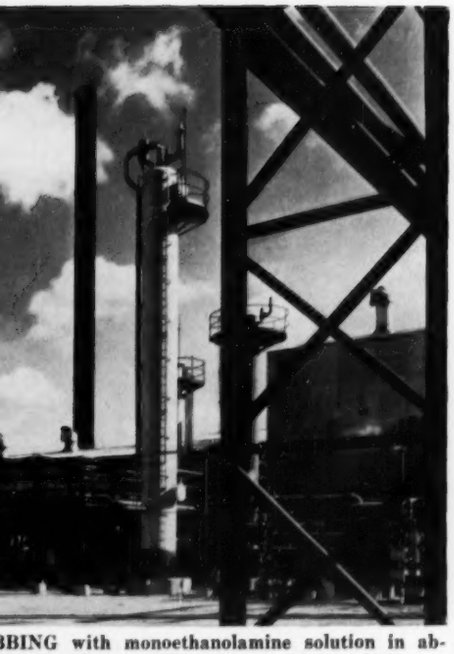


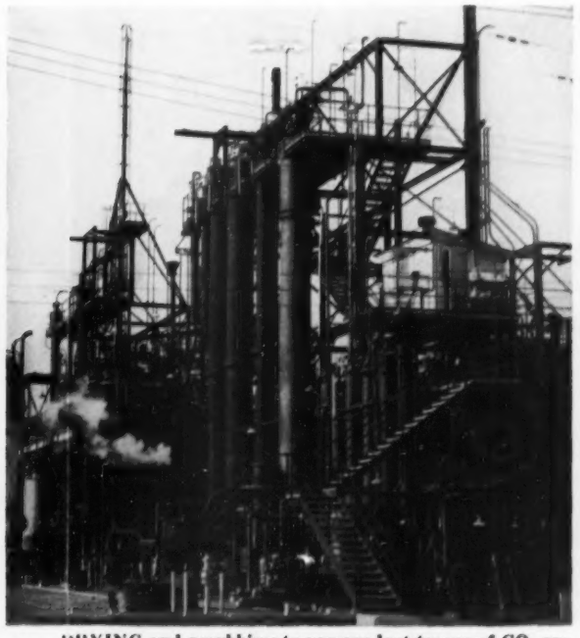
1 **REFORMER FURNACE, where natural gas reacts with steam over a nickel catalyst to produce CO, CO_2 and H_2.**

2 **SCRUBBING v sorption towers**

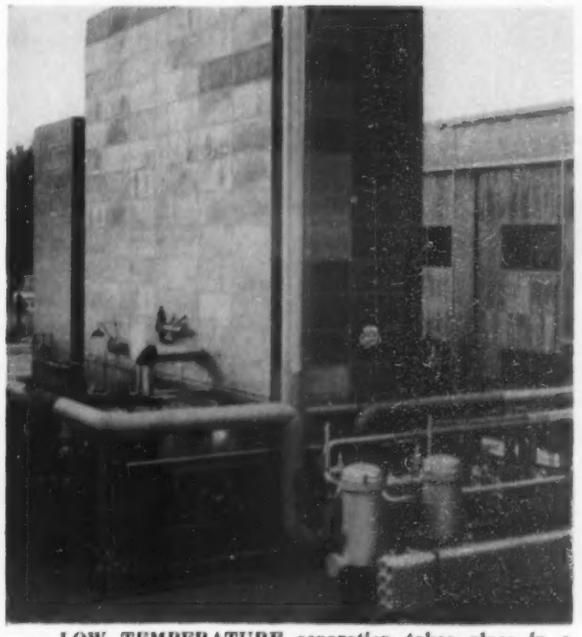




BBING with monoethanolamine solution in ab-
n towers lowers CO_2 content to about 0.05%.



3 DRYING and scrubbing to remove last traces of CO_2 are necessary prior to low temperature treatment.



4 LOW TEMPERATURE separation takes place in a double fractionating column. Products: pure CO and H_2.

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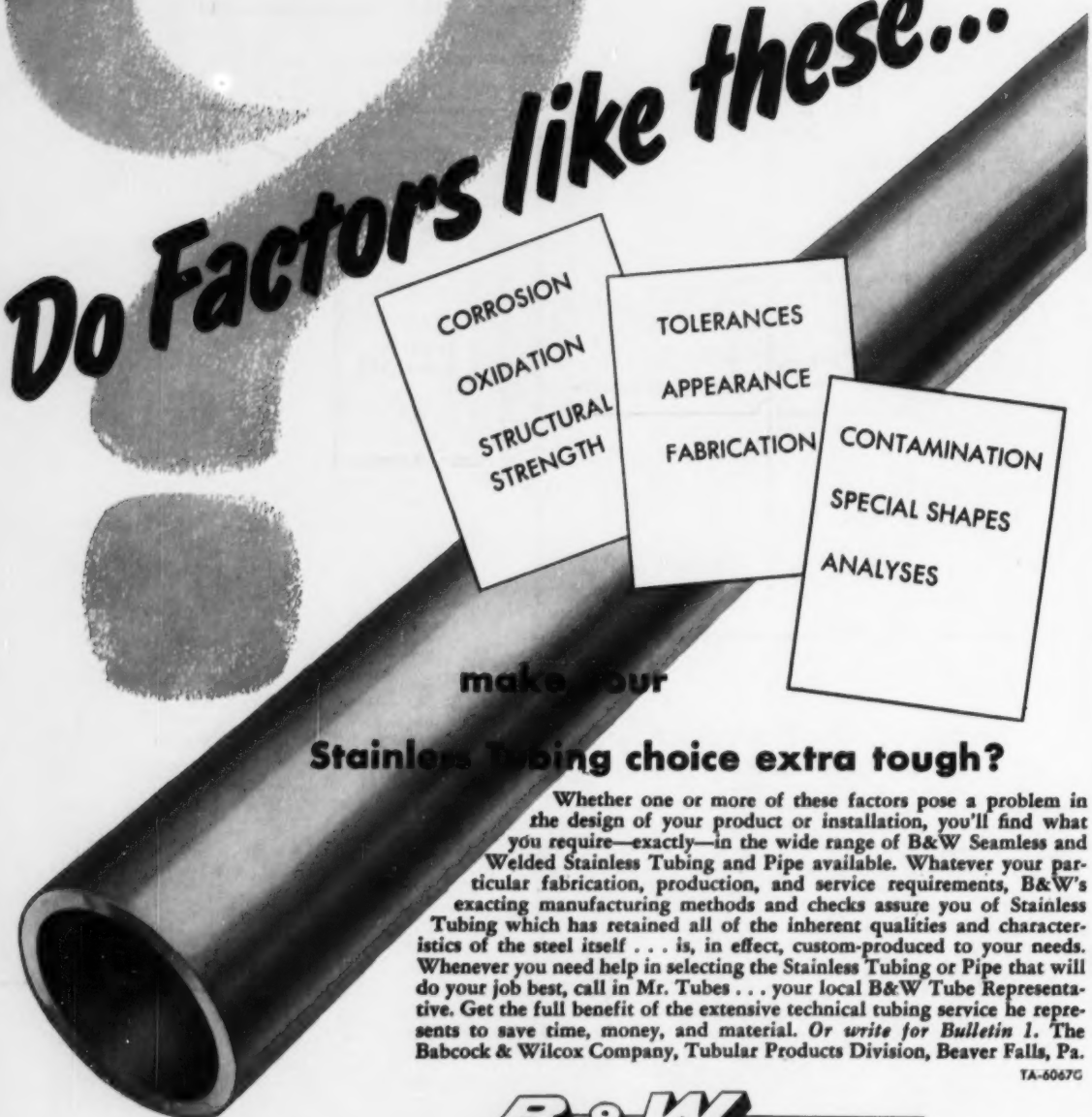

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It's unanimous! These Crane valves for the process industries were *especially designed* of Crane alloys to cope with costly corrosion and to cut replacement costs.

The gate valves feature a simple, split-wedge disc construction which permits discs to rotate freely within guides and to seat tightly at all points on the seat perimeter. The free movement of the disc, plus uniform seating and unseating loads, minimizes galling and seizing, reduces wear and allows smooth operation under all conditions.

Globe and angle valves now feature a modified plug-type disc that combines the advantages of the easier seating of the narrow ball-to-flat seat and the high resistance of the wider plug-type disc to corrosion, erosion and cutting. In addition, these valves offer a new swivel disc-stem connection that seats the disc squarely every time. Minimum clearance eliminates vibration.

These valves are available in 18-8 SMo and Craneloy 20 . . . in gate, globe, angle and check patterns . . . ½" to 6" . . . screwed or flanged ends. Rated 150 p.s.i. at 500° F.—230 p.s.i. at 100° F. *For more detailed information*, confer with your CRANE representative or write to the address below for the 12-page circular AD-2080.

Split-wedge disc gate.

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New swivel disc stem connection in globe and angle valves permits the disc to swivel freely on contact with seating surfaces.

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If you are under pressure to achieve still higher production or if you have a special pulverizing problem that requires a quick solution then this versatile Imp Mill may be just the right answer.

It is a compact unit that will fit readily into your plant layout and provide an economical installation for handling a variety of jobs simply by different arrangements of the equipment.

It offers scores of uses in the non-metallics industries:— For disintegrating, blending and classifying materials to make uniform, intimate mixtures . . . for grinding and drying in one operation . . . for making extreme fine powders in combination with a Raymond Mechanical Air Separator, or removal of fines for producing granular materials with supplementary screen separation.

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Combustion Engineering-Superheater Ltd. Montreal, Canada

Man of the Month: Robert York

Cornell snares former Monsanto executive — with ideal industry-teaching record—for Socony Mobil professorship

When Bob York settled down at Olin Hall on the Cornell University campus, this fall, he became the first to accept a unique kind of professorship. The new chair, sponsored by Socony Mobil Oil, aims primarily at giving undergraduate instruction in chemical engineering a boost and is probably the first of its kind to be set up by an American university.

Its support is provided by a five year grant rather than by the usual enormous endowment sum. Thus the university is given a real lift while the firm avoids extensive and complicated monetary arrangements.

To fill the position, Cornell looked for a man, nationally recognized for his work in his field, who'd had extensive experience in private industry.

So Bob York, who filled the bill, and offered a good backlog of teaching experience besides, left his St. Louis post as assistant director of Monsanto's general development department and headed northeast toward Ivy League territory.

In doing so, (despite the fact that he's got a lot more to offer students now than he did before he went with Monsanto) he's right back where he started from —careerwise. That is, he's back —in the classroom and in the Northeast—where his career in chemical engineering actually began.

▶ **The Magnetic North**—Though he was brought up in Memphis, Tenn., York's career in chemical engineering actually traces its origin to New England.

It happened like this: During the early thirties, while working for a master's in mechanical engineering at the University of Tennessee, York became intensely interested in air conditioning—the subject of his thesis. This interest soon opened up the vast field of chemical engineering to him. On top of that, his extensive reading in the field did much to influence him. In particular, MIT's W. K. Lewis and T. K. Sherwood were the real propagators who "converted" him.

In the fall of 1934, he took up residence on the Cambridge campus where he worked as an assistant in teaching and in research. Four years later, MIT awarded him a doctorate in chemical engineering.

Then, in 1938, he moved on to Carnegie Tech's campus in Pittsburgh; his forte there was thermodynamics. Off campus, he engaged in some consulting work and, during the war, he was active in directing research on activated carbon.

He took a year's leave of absence in 1945 to get industrial experience with Monsanto, returned to Carnegie for a year or so, but finally decided to go back to St. Louis. There until the spring of this year, he has been engaged in development work—in on such assignments as Monsanto's vast polyethylene project down in Texas City.

▶ **"Southern Yankee"**—That's what his friend, Dean W. McCabe over at Brooklyn Polytech calls him whenever he looks back on Bob's mixture of New England and Tennessean tendencies.

And, Carl Monrad—department head at Carnegie Tech—says that, originally, York "had a good Southern accent which got confused with a bit of Bostonian so that, these days, York doesn't know whether he should add an 'r' or take one off."

Despite the northern influence, though, it isn't likely that York will ever forget the South. The day before school opened, this fall, he optimistically took stock of the fact that his office had a southern exposure which could catch whatever sunlight might come along. (Cayugans

DAY CLAY MIXER . . . . the most advanced design available anywhere, has a record of productivity that is virtually unequalled. A service story from a large paper company, testified that a Day Cincinnatus Clay Mixer dispersed within 60 minutes a 75% solids, clay mix, into a homogenized product, with binder savings averaging 10 to 20%.

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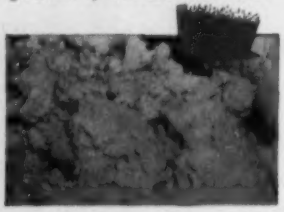

Unretouched photo of 75% solid clay mix used in test

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can tell you that there's not an awful lot of it to be caught!)

But just in case there are too few sunny days to help him remember the warmer hills of home, York has another recourse. Over a bookcase, hanging in a prominent place, is a rather attractive reproduction of a Smokey Mountain landscape —a picture which really does justice to his favorite vacation spot.

Just a glance and York can recall the North Carolina hills where he can enjoy the quiet of his cabin and hobnob with the hill folk nearby. There, too, according to rumor, his normal neatness disappears for a few pleasant weeks and he can take off his shoes and relax.

▶ **Exacting and Effective**—Once back on the job, York's usual meticulousness returns. Monrad says it shows up in his writing, in dining habits (he has a unique way of sprinkling salt), and in his handling of courses and students, too. When Bob says a job is finished, it is really polished and complete.

McCabe, too, likes to recall Monrad's observation that to teach thermodynamics well, a man has to be—like York—an Episcopalian: with a definite leaning toward preciseness and perfection in everything.

Thus, his thoroughness makes him a mighty good—though demanding—teacher and results show it. And to make a thorough job of his work, he sees to it that he gets to know students outside the classroom as well. Former students at Carnegie recall a few spaghetti supper "get togethers" on Friday nights after class and even a weekend excursion to Cleveland to take in a concert.

▶ **Pro Musica**—The concert served a dual purpose, though: It gave York an opportunity to enjoy one of his favorite interests—classical music. In fact, three or four of eleven big crates which were delivered to his office this fall were stacked with phonograph records.

The collection shows York's real love of folk and western music, in addition to the classics. But, he definitely hates the "hillbilly" variety and has no comment whatsoever to make about his fellow Tennessean of "rock and roll" fame.

▶ **Point-Counterpoint** — When York moved to the Cayuga acropolis this fall, he said simply that, for a start, he would take on courses in chemical technology and plant design; that he was bringing to the school a broader picture of the field and a better grasp of the crucial economic aspects of chemical engineering than he'd ever had before; and that he would stay in close touch with industry as a consultant.

But when York's associates rate his value to the school, they have a lot more to say:

McCabe speaks of "the highly difficult problems which confronted York at Monsanto" and of the "high degree of technical competence" which helped him resolve them.

Drs. Wiegandt and Winding at Cornell put it this way: "No doubt about it . . . York really has both feet on the ground on all technical questions."

And Monrad likes to recall this story about the recognition of York's ability:

As an instructor and assistant professor at Carnegie, Bob York came into contact with an associate—who had very European ideas on academic life. For the latter, only associate professors and those of higher rank were "colleagues"; lesser fry were ignored! By chance it wasn't long before the two were involved in a technical battle. In the outcome, York won (specifically, by proving that gases are different from liquids in their response to temperature on viscosity). From that time forward Bob was a colleague.

At 44, Bob York is a young and valuable addition to the Cornell campus. And the department is might happy to have him around.

Raymond E. Fiedler has been appointed manager of agricultural products development for Archer-Daniels-Midland. Before joining ADM, Fiedler had been with Stanley Mfg. Co.

Fred W. Cox, Jr., has been appointed manager of Atlas Powder's Reynolds Experimental Lab in Tamaqua, Pa. Cox succeeds **Guy Rolland,**

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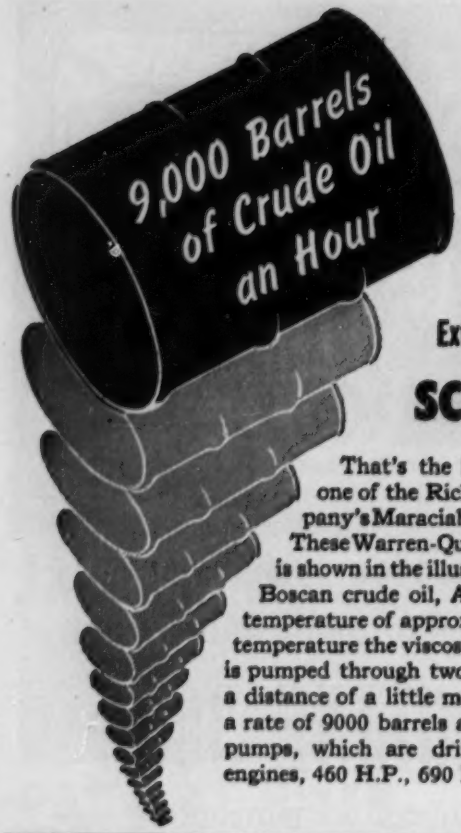

USING 3

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External Gear and Bearing

SCREW PUMPS

That's the hourly loading record at one of the Richmond Exploration Company's Maracaibo operations in Venezuela. These Warren-Quimby Pumps, one of which is shown in the illustration, are used to pump Boscan crude oil, A.P.I. Gravity 10.5°, at a temperature of approximately 160°F., at which temperature the viscosity is 6000 S. S. U. The oil is pumped through two 18" submarine pipelines a distance of a little more than one mile and at a rate of 9000 barrels an hour, using three such pumps, which are driven by Nordberg diesel engines, 460 H.P., 690 R.P.M.

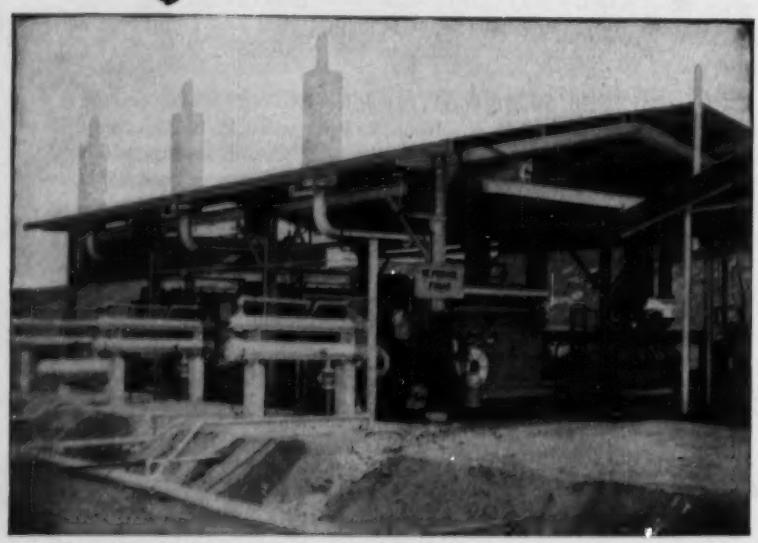

Illustration: Courtesy, Standard Oil Company of California

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Warren, Massachusetts

NAMES . . .

who has been named assistant to **William J. Taylor, Jr.**, director of the explosives research department.

Edwin F. Morfit has been appointed head of manufacturing for Sylvan Plastics, Inc., at American Viscose' film division plant in Fredericksburg, Va.

H. C. Twiehaus

Columbia-Southern Chemical's new assistant technical director is H. C. Twiehaus, former manager of the planning department.

He has been associated with the firm since 1940, when he joined the development department at Barberton, Ohio. Since that time he has held various supervisory positions at the firm's New Martinsville, W. Va., and Lake Charles, La., plants.

Twiehaus is a graduate of Kansas University, a member of AIChE and Electrochemical Society.

Carl C. Georgian has been named group leader in the technical service division of the research and development department of the American Oil Co., Texas City, Tex.

Leo J. Novak has been promoted to vice president, chemical director, of Commonwealth Engineering Co. of Ohio. He has been with the firm since 1951.

Elzie Wolker and **Quentin R. Jeffries** have been added to the engineering staff of Commercial Solvents Corp. Both men will make their headquarters in Terre Haute, Ind., at the research and production center.

Paul Hopper has been transferred from Washington to New York to manage consumer products development for American Cyanamid's fine chemicals division.

J. B. Levy has recently joined the staff of the chemical engineering division of Atlantic Research Corp., Alexandria, Va. Formerly, Levy was senior research associate in the U.S. Naval Ordnance Lab's explosives research dept., Silver Spring, Md.

Olin M. Herner has been assigned to the position of chemical engineer in Commercial Solvents' engineering department.

Robert B. Mesrobian has been named associate director of research, high polymer chemistry, Continental Can Co., in the newly created central research and engineering division.

Robert L. Amsler has been promoted to group leader of the product group, in the research and development division of Chemstrand Corp.

Robert J. Oullette, University of Vermont, and **Arthur B. Larsen,** Case Institute of Technology, were among seven winners of the $100 chemistry achievement award sponsored by Chemical Rubber Co., Cleveland.

George W. Struthers has accepted an appointment as administrative assistant in the technical section of the Du Pont Co. plant located in Belle, W. Va.

David J. Rex has been appointed to the newly created post of process engineer for the silicate, detergent calcium division of Diamond Alkali Co., Cleveland. **Vance P. Edwardes** has been named consultant to the soda products division.

Norman O. V. Sonntag has been named to the research staff of Emery Industries, Inc., Cincinnati. He'll take charge

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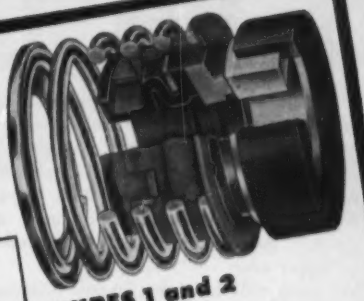

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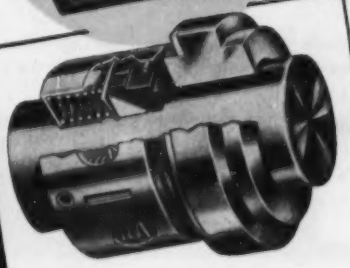

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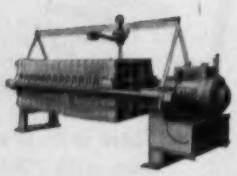

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NAMES . . .

of research in the field of synthetic lubricants for jet and gas turbine engines. He had been chief chemist for Celanese' chemical division.

Neil S. Kocher, former manager of film manufacturing, has been named assistant general manager of the Kodak Park works, Eastman Kodak Co., Rochester, N. Y.

Charles L. Fleming, Jr., has been elected a vice president and a director of Esso Research and Engineering Co. He succeeds **Carl O. Tongberg,** who resigned recently to become a vice president and a director of Carter Oil Co.

John E. McKay has been appointed to the business development staff of Ralph M. Parsons Co., Los Angeles. Formerly he had been associated with Fluor Corp.

Wilford N. Hansen, former research assistant with the Ames (Iowa) lab of the Atomic Energy Commission, has joined Atomics International, division of North American Aviation, where he is conducting research on high temperature fuel processing and other physical chemical problems.

Marlin G. Geiger has been elected executive vice president in charge of the chemical group composed of the seven chemical divisions of W. R. Grace & Co.

Milton Weiner has been appointed to the chemical insulation unit of General Electric Co.'s materials and processes lab, large steam turbine-generator department.

Arthur Schooley and **Robert F. Sterbenz** have joined the technical staff of B. F. Goodrich Co. at the Brecksville, Ohio, research center.

Joseph C. Cameron has been appointed works manager of the Carthage, Mo., works of Hercules Powder Co. **John E. Greer** has been selected to

succeed him in his former position as works manager of the Pluto Works, Ishpeming, Mich.

J. A. Anderson, Jr., has been promoted to research associate, and **E. W. Bowerman,** to assistant division head in the research and development division at Humble Oil & Refining Co.'s Baytown, Tex., refinery.

Francis T. Wadsworth

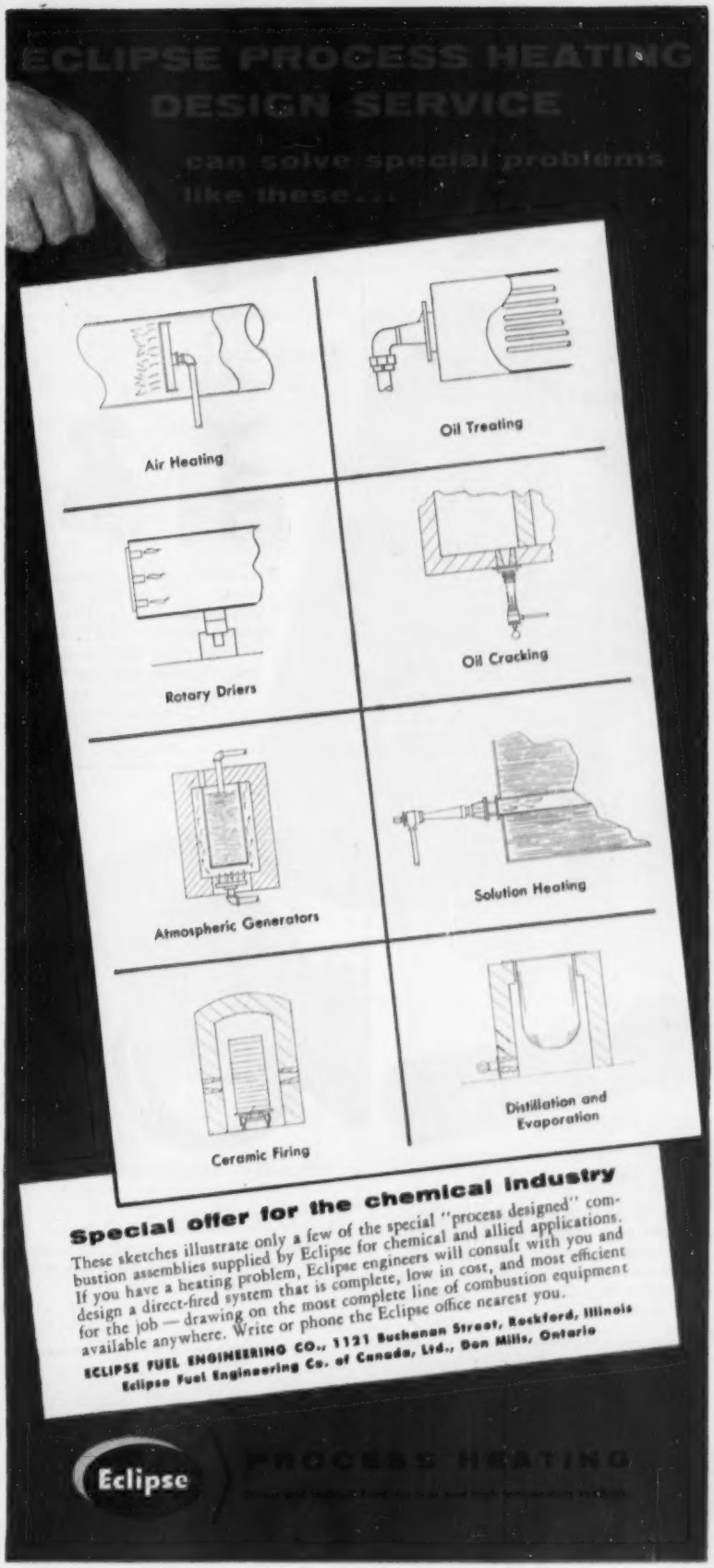
American Oil Co., Texas City, Tex., has just appointed Francis T. Wadsworth to the position of assistant director of its research and development department. Wadsworth, who formerly headed up operations in the chemicals section, will now take charge of the department's research division.

Except for a few brief academic leaves in 1946 and 1947, Wadsworth has been in the firm's employ since 1942. He began in the exploratory research section and later was assigned to the chemicals division. He was named section head of the latter in 1951.

Wadsworth completed his undergraduate work at Missouri State College and did graduate work at the University of Missouri.

Henry E. Wessel has been named manager of product development for International Minerals & Chemical Corp. Before joining International, Wessel had served as manager of the engineering economics division of Midwest Research Institute.

H. F. Fraser Johnstone has been appointed research professor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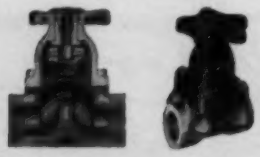

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ACE processing equipment of rubber and plastics

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NAMES . . .

of chemical engineering at the University of Illinois. Johnstone is a specialist in the fields of air pollution problems and aerosols.

W. E. Armantrout has been named production superintendant at the Mead reduction works of Kaiser Aluminum & Chemical Corp. He joined Kaiser in 1948 after graduating from the University of Michigan.

William S. Emerson

William S. Emerson has joined American Potash & Chemical Corp. as manager of research at the firm's Whittier, Calif., research laboratory.

Formerly Emerson worked with Monsanto Chemical as assistant development director in St. Louis, Mo. He joined Monsanto in 1941 after three years as an instructor at the University of Illinois.

Emerson graduated from Dartmouth College in 1934. Later he studied at Massachusetts Institute of Technology, where he received a Ph. D. in 1937.

Clarence L. A. Wynd and **Louis K. Eilers** were elected vice presidents of Eastman Kodak Co. Wynd, a chemical engineer, is an assistant general manager of the firm's Kodak Park works. Eilers, a chemist, is also a director of the Eastman Gelatine Corp., Kodak subsidiary.

Alvin J. Donius was recently appointed to the staff of the Tonawanda, N. Y., labs of Linde Air Products Co. His present assignment is with the development group.

Preston Parr, Jr., has been appointed associate dean of students at Lehigh University. Parr, a graduate of Lehigh in 1943, has been assistant director of the Lehigh Institute of Research since 1949.

C. Howard Adams has been appointed manager of plastic product development for the general development department of Monsanto's research and engineering division.

Raymond J. Burkett and **Paul F. Murray** have been added to the production staff of Monsanto Chemical's plastics division in Texas City, Tex. **Elton I. Wade** has joined the technical service department.

James R. Johnson has been named technical coordinator of Minnesota Mining & Mfg. Co.'s atomic energy program. From 1951 until early this year, he had been technical advisor of the ceramics section of Oak Ridge National Laboratories, Oak Ridge, Tenn.

J. L. Ober, retired vice president of Scott Paper Co., has been reelected president of the University of Maine Pulp & Paper Foundation.

Hilliard D. Cook has been named lecturer and consultant in pulp and paper technology in the School of Forestry at North Carolina State College. For the past several years Cook has been self-employed as a consulting engineer.

Henry Schiessl has been appointed technical assistant to the manager of research and development of the industrial chemicals division, Olin Mathieson Chemical Corp.

Arthur L. Goeschel has been appointed manager of the Santa Rosa plant of NRC Metals Corp. He had been manager of the Niagara Falls plant of Stauffer Chemical Co.

Michael F. Coyne, president of California Oxygen Co., San Francisco, has been made

NO SHAPE TOO SCREWY
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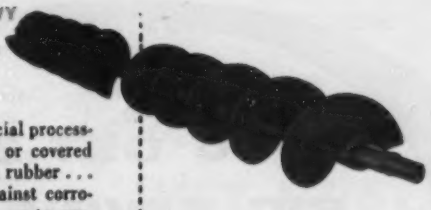

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED • TORONTO

director of Pacific Oxygen Co., Melbourne, Australia.

Richard T. Yates, manager of Hercules powder's agricultural chemicals division, naval stores department, has been given a special assignment to investigate new fields of chemistry in which the company is interested.

Bruno H. Wojcik

Olin Mathieson Chemical Corp. has just named Bruno H. Wojcik manager of research and development in the industrial chemical division.

Wojcik came to the firm in 1950 from Hooker Electrochemical Co., Niagara Falls. He's best known for his work in the polymerization and high-pressure hydrogenation fields, and he holds a number of patents on the preparation of organic sulfides, fluorides and chlorides.

A native of Chicago, Wojcik received his undergraduate degree from the University of Illinois and his doctorate in chemistry from the University of Wisconsin. During World War II he served on the chemical staff of the Manhattan Project.

W. L. Kleiber has been named manager of the Rochester, N. Y., plant of the industrial chemicals division of Olin Mathieson Chemical Corp.

William B. Plummer has opened an office in New York's Lincoln Bldg. as a consultant in petrochemical and related fields.

D. H. Francis has been appointed director of engineering and a member of Stepan

Chemical's executive committee. **William O. Ranky** is now director of laboratories.

Eugene P. Whitlow has been appointed senior physical chemist, department of chemistry and chemical engineering, at Southwest Research Institute.

Robert E. Payne has been named director of research for Sharples Corp., Philadelphia. Payne will also serve as technical advisor on production of centrifugal equipment.

A. Stanley Thompson, former chief engineer of the nuclear power department, Studebaker-Packard Corp., has joined the general atomic division of General Dynamics Corp.

Malcolm M. Coston has returned to Swenson Evaporator Co., a division of Whiting Corp., after three years as manager of the process equipment division of Rodney Hunt Machine Co.

Ferdinand G. Brickwedde, chief of the heat and power division, National Bureau of Standards has been named dean of the College of Chemistry and Physics at Pennsylvania State University.

Morris Beller has just been appointed to the Tonawanda, N. Y., labs of Linde Air products Co. Before coming to Linde, he was associated with Atlantic Gummed Paper Corp.

Arthur F. Roche has succeeded **A. T. Maasberg** in the position of technical director of plastics production for Dow Chemical Co. Formerly he was Maasberg's assistant.

Bernard L. Evering, pioneer in aviation gasoline research, has been appointed a senior research associate in Standard Oil Co. (Ind.) research department at Whiting, Ind.

Thomas E. Croxson has joined the research and development

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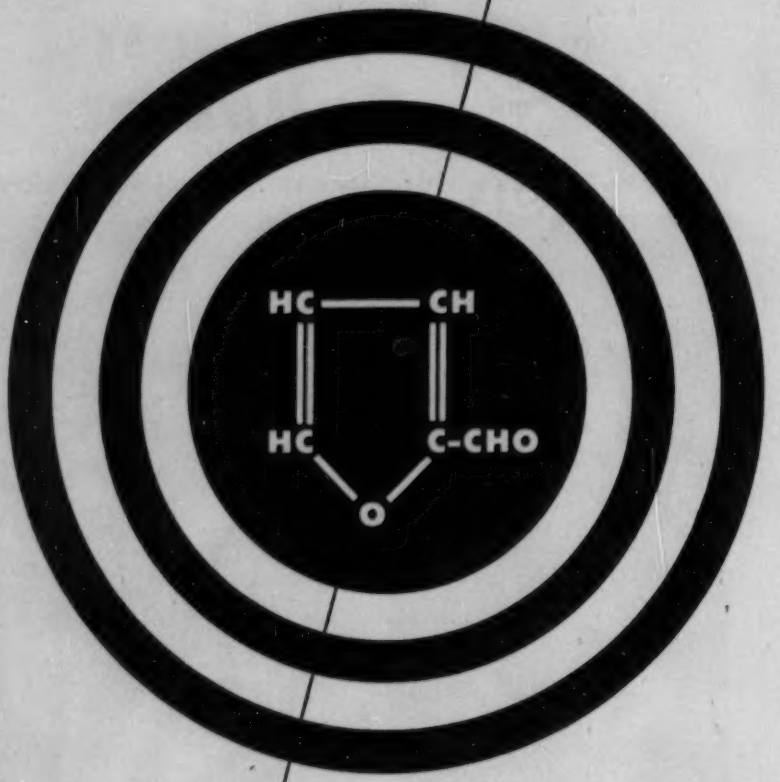

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In Japan: F. Kanematsu & Company, Ltd., Tokyo

NAMES . . .

division of Chemstrand as acting group leader of the Acrilan dye application group in Decatur, Ala.

N. Dudley Steele has been promoted to the position of general production superintendent of carbon black for Godfrey L. Cabot's southwestern division.

A. T. Maasberg

Technical director of plastics production for the past two years, **A. T. Maasberg** is now director of research and development for Dow Chemical's Midland division.

In cooperation with production managers and research and laboratory directors in the division, Maasberg will assist in the improvement of manufacturing processes and product characteristics. He'll also provide liasion with the firm's director of research and the executive research staff.

A Dow veteran of some 20 years, Maasberg came to the company in 1936 as a chemist in the cellulose semiplant. That was just after graduation from Syracuse University. By 1948 he was research director for the cellulose department and, in 1952, manager of cellulose products.

Charles H. Braithwaite has been named laboratory section director of Food Machinery & Chemical's Westvaco Chlor-Alkali research and development department. Before 1951, he had been with Westinghouse and Shell Oil.

Henry L. Coles, head of the department of chemistry and chemical engineering at

Michigan Tech since 1940, has resigned to accept a position with the Naval Ordnance Test Station at China Lake, Calif.

Alden R. Loosli has been appointed general manager of American Cyanamid's new fibers division. **C. W. Bendigo,** a former editor of McGraw-Hill's *Textile World*, has been named technical director. **N. H. Marsh** will manage the Florida Creslan plant.

Benjamin Linsky, director of Detroit's air pollution control board for the last five years, has been appointed director of the newly formed San Francisco Bay Area Pollution Control District.

Thomas P. Turchan has been appointed assistant general manager, industrial chemicals division, American Cyanamid Co. Till now he had handled the firm's agricultural chemicals division.

Ralph E. Oesper, professor emeritus of chemistry at the University of Cincinnati, has been named the first recipient of the new Dexter Chemical Corp. award in the history of chemistry.

Daniel A. McBride and **Eugene L. Olcott** have been added to the staff of the chemistry division of Atlantic Research Corp. McBride will serve as project coordinator; Olcott will work mainly on metallurgical engineering problems.

Edward J. Mendyka and **Michael J. Geregach** have joined the staff of B. F. Goodrich research center as chemist and junior technical man, respectively.

OBITUARIES

James J. Kerrigan, 62, until recently president of Merck & Co., Rahway, N. J., died September 6 after a long illness. At the time of his death he was chairman of the executive committee of the board of directors.

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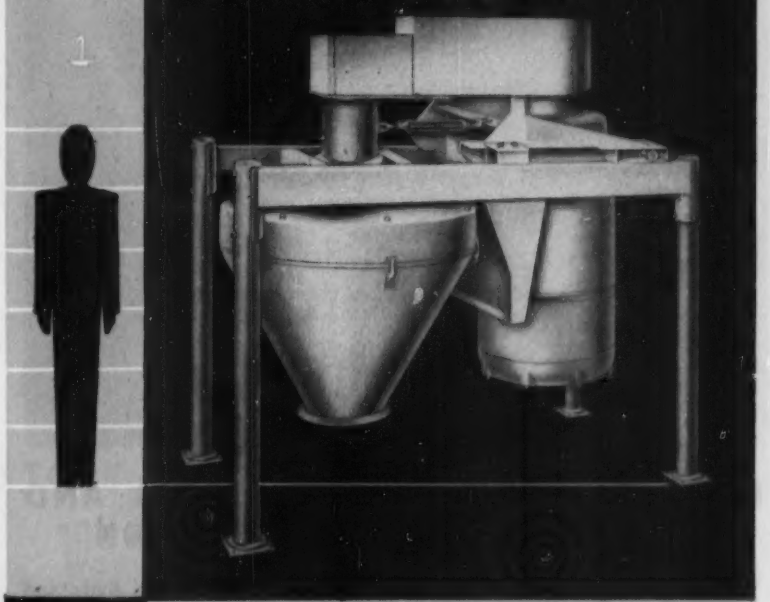

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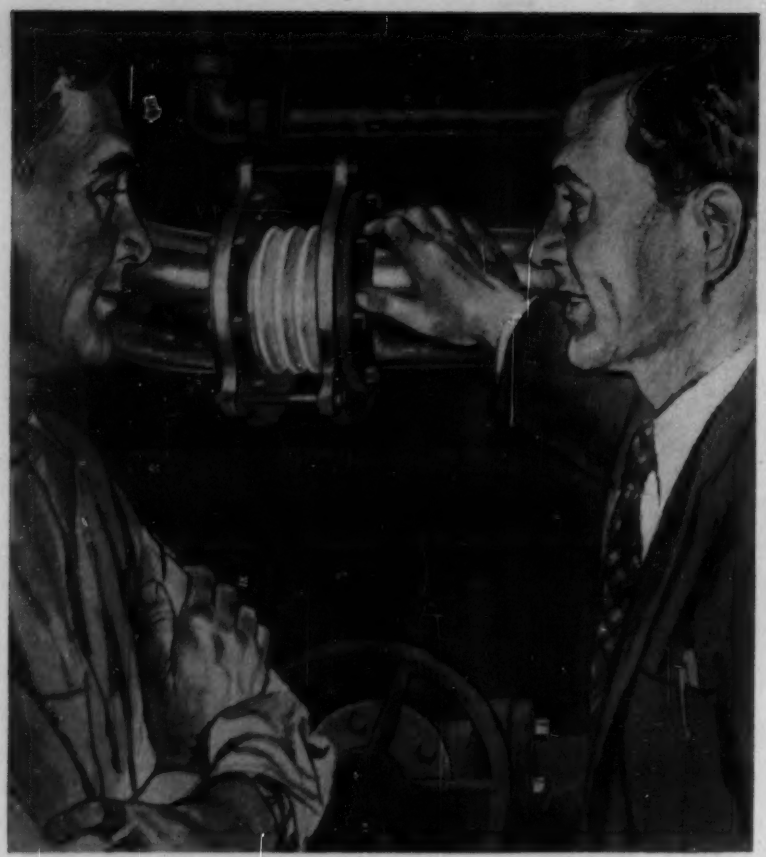

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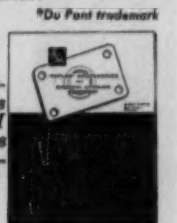

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Letters:

Chemical Engineering Pays

Sir:

In response to Dr. Stewart's question, "Does Chemical Engineering Pay?" (Sept. 1956, pp. 192-194), I should like to join thousands of engineers in a resounding YES.

As a member of the class of 1951, I hasten to assure Dr. Stewart that the chemical process industries have done better by me and my classmates than to put us on an equal salary level with the graduates of the class of 1956. We hasten to extend to Dr. Stewart the same condolences that went out to the political poll-takers who picked Mr. Dewey in the 1948 presidential race.

It is a disappointment to find a magazine of the caliber and prestige of *Chemical Engineering* subscribing to a type of crystal-gazing that is so definitely detrimental to the chemical engineering profession. I suggest a stricter adherence to the editorial policies and principles which have made your magazine the leader in required reading for all chemical engineers.

ROBERT J. FORD
Chemstrand Corp.
Decatur, Ala.

. . . Or Does It?

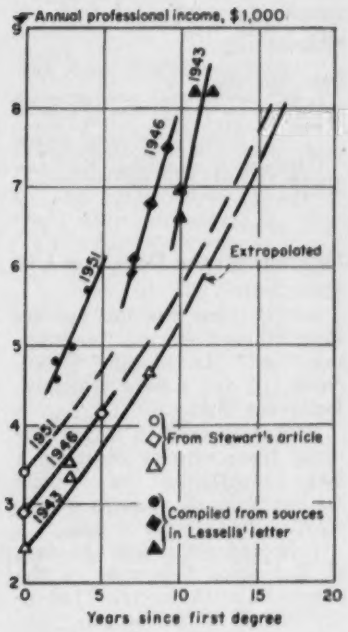
Sir:

My first impression on seeing Dr. Stewart's article was the hope that it would draw attention to the inequities existing in engineers' salaries. I'm afraid, however, that on careful perusal of the article I find some of the data upon which the author's most salient conclusions are based to be wrong.

Dr. Stewart's graph (Fig. 1, p. 192) plotting annual income vs. years since first degree has long lengths of extrapolated curves for the graduating classes of 1943, 1946 and 1951. The only basis for these extrapolations is Dr. Stewart's statement, "Since all the curves in this plot are approximately parallel, they have

Pro & Con

C. H. CHILTON



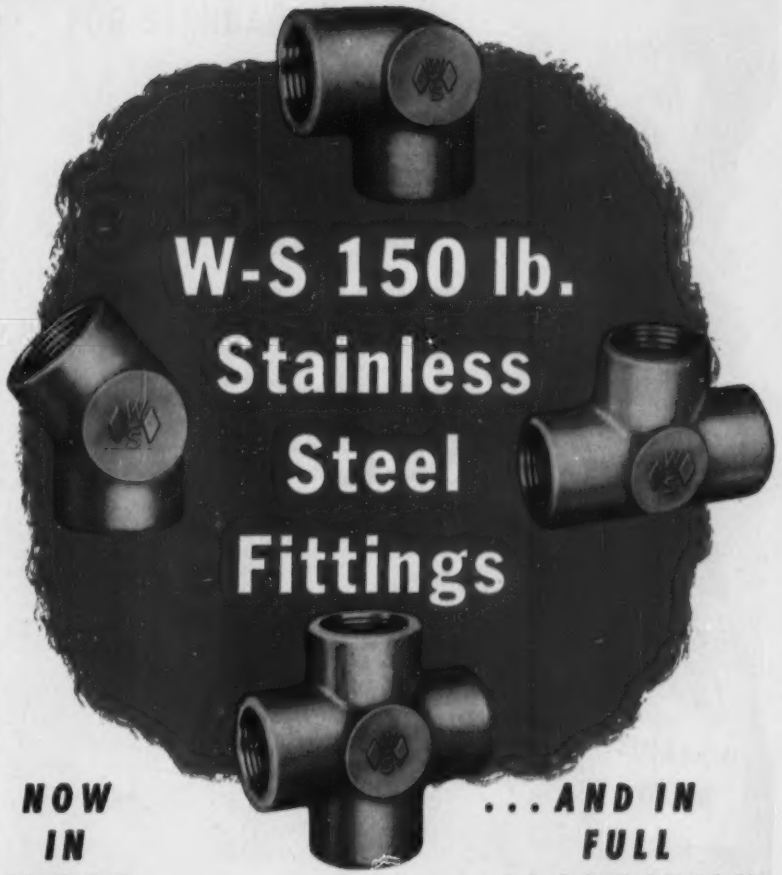
been extrapolated on that basis where required."

However, I have plotted data taken from four published sources* for the three years in question (*see above graph*). It is obvious that the agreement among the assorted data is excellent, and that the correlation curves are far removed from Dr. Stewart's extrapolated ones. In fact, the extrapolated curves reach a maximum deviation which corresponds to a value of only two-thirds of the curves derived from my four sources.

It is unfortunate that Dr. Stewart made these extrapolations, since his subsequent conclusion that graduates of these classes must wait 18 to 30 years to pay off their college education is completely in error.

There is no doubt that many engineers out of school five, ten or more years are lagging behind as starting salaries rise, but the picture is not nearly as bleak as Dr. Stewart paints it. It would behoove those genuinely interested in calling attention to inequities in engineering pay to

* See references at end of letter.



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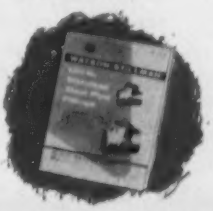

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be armed with as many facts as possible before leaping.

GERALD A. LESSELLS
Olin Mathieson Chemical Corp.
Brandenburg, Ky.

*REFERENCES
1. AIChE questionnaire, *Chem. Eng. Prog.*, Jan. 1954.
2. ACS professional and economic survey, *Chem. & Eng. News*, April 9, 1956.
3. "How Does Your Current Salary Stack Up?" *Chem. Eng.*, July 1955.
4. Industrial salary data from Los Alamos Scientific Lab, *MIT Technology Review*, Dec. 1953.

Depends on the Data You Use

Sir:

At the time I wrote my article, "Does Chemical Engineering Pay?" Mr. Lessells' References 1, 3 and 4 were available; Reference 2 was not.

BLS data used in my article came from surveys covering a large proportion of the chemical engineers in all sections of the country, in all types of jobs.

I decided not to use the data of Reference 3 because of the small size of the sample (140 individuals), its limited geographical distribution (Metropolitan New York) and its preponderance of replies from administrative people.

Data of Reference 4 were obtained by questionnaires to employers (not employees) and included, in all probability, only a very small number of chemical engineers in the very heterogeneous group sampled. Therefore, these data also were not considered comparable to the BLS data and were not used.

Data of Reference 1, the AIChE survey, apparently did not line up with the BLS data. This was disturbing, as they seemed to be valid data from a sufficiently large and random sample. I decided not to use them on the asumption that the AIChE group was probably an "elite" sample and therefore not comparable to the BLS sample. Certainly, AIChE membership qualifications tend to make it an elite group.

The recently published ACS data (Reference 2) should be comparable to the BLS data. Many (possibly all) of the BLS surveys were made in cooperation with the ACS. These data show, as brought out by Mr. Lessells, that my extrapolations

were not valid. The fact that the data of the other three references (with the possible exception of Reference 1) agree with the ACS data, I consider to be fortuitous and not to be expected.

Revising the engineers' income data (my Fig. 1) on the basis of the ACS data of April 1956 and, from that, revising my graph on lifetime earnings (Fig. 4), and again extrapolating (a most risky procedure, as Mr. Lessells points out) the earnings curves for the classes of 1943 and 1951 to the break-even (100%) point, we get:

Class	1943	1951
Break-even point		
Original prediction ...	18 yr.	30 yr.
Revised prediction	12 yr.	15 yr.

As Mr. Lessells points out, this revised estimate — still fraught with uncertainty — is considerably less bleak a prospect than was the original estimate.

Although modified in degree, however, the conclusion presented in the original article is still valid: As time progresses the median engineering graduate is in an increasingly less favorable economic position as compared with the average craftsman.

Additional support for this point is the advertisement appearing in the San Francisco *Chronicle* of Sept. 9, 1956, for Richmond (Calif.) rookie policemen (high school graduates, good health, at least 5 ft. 10 in. tall) to start at $425 per month. This is the same figure as many June 1956 engineering graduates received.

PAUL B. STEWART
University of California
Berkeley, Calif.

Statistics Errata

Sir:

Several typographical errors and one otherwise unaccountable mistake were included in my "Industrial Statistics" report (March 1956, pp. 165-190). Thanks to the many interested readers who pointed out several of these errors:

P. 168, Table II: In the third hypothesis, replace the minus sign with an equals sign.

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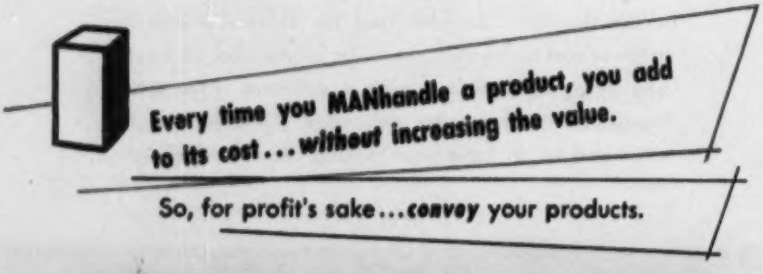
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PRO & CON . . .

P. 176, top of Column 1: Final value of the rank correlation coefficient in the example is −0.16, not −0.84. This low value of the coefficient is *not* significant and there is no basis for assuming a correlation.

P. 177, Example 4: The first value of y is 4.17, not 4.27.

P. 179, Table VI: In the expression for b in the second column, delete the first exponent (square). The expression for $s^2(b_2)$ in the third column should be $c_{22}s^2(Y)$.

P. 180, Example 5: $\bar{x}_2 = 5.0000$

$$\Sigma' x_1 y = -1.2400$$

$$y = 9.8947 - 1.9188\ x_1 - 0.2903\ x_2$$

$$y' = 89.8947 - 191.88 \text{ etc.}$$

Final equation:

$$y' = -101.99 + 1.92\ x'_1 - 0.29\ x_2$$

WILLIAM VOLK
Hydrocarbon Research, Inc.
Trenton, N. J.

Pro: Linear Programming

Sir:

I was interested in reading the two articles on linear programming in your August issue (pp. 211-216). Both articles successfully covered a great deal of territory in limited space.

One thing which I have noticed in linear programming articles published in technical journals is that they all deal with multiproduct plants involving problems of blending, storage, shipping and the like. Probably this is the area in which linear programming has its most attractive application.

On the other hand, I have been interested in the idea of applying this technique to problems of optimizing design or operations where changes in process variables—temperatures, pressures, reflux ratios, etc.—are involved. It is true that often the restrictions are not linear relationships, but by selecting a small enough range of the variables involved they can be made to approach linearity.

Linear programming can thus be applied to situations in which the complexity is in the plant design itself and so be used to supplement the familiar economic balance procedures employed by chemical engineers.

JOHN HAPPEL
New York University
New York, N. Y.

To Seal or Not to Seal . . .

Sir:

Your September report on Mechanical Seals for Abrasive Liquids (pp. 199-210) caught some of the boys in the back room in a mellow mood—with the accompanying result. There is some question whether any reasoning in the usual sense went into it, but if we can assume it was actual cerebration, then they evidently reasoned somewhat as follows:

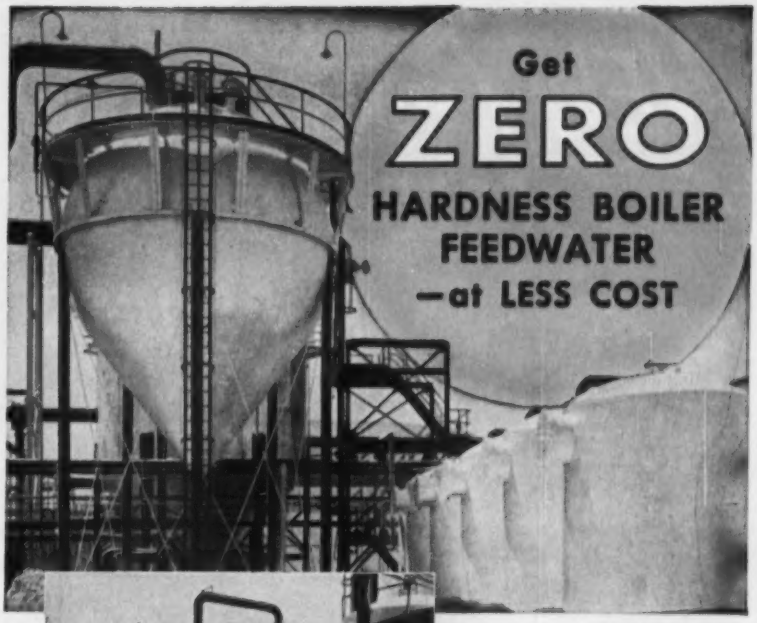
In these days of the mechanical age we have iron horses, tin fish, *cat*-erpillar tractors—not to mention electronic brains and test-tube babies. Mink are even getting along without mink, dynel substituting in mink coats. Author Norton really has a brainstorm here; why not mechanical seals?

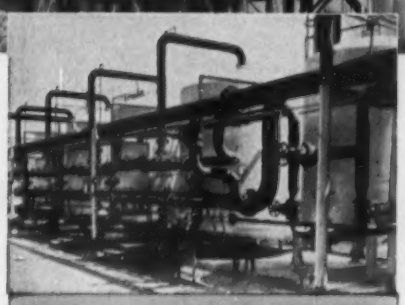
Without further ado they shook up the concoction you see above.

PULLEN M'LEGG
Old Fashioned Chemical Co.
Rye, N. Y.

► *As the astute reader will recognize, Mr. M'Legg is a spoofer. What really happened was very simple. An overworked CE editor had one of those sudden brainstorms that come on hot summer days. This he communicated to Staff Artist Al Hansen. Al—working in secret—put our little pet together with pen and paste just in time to give the report editor the shock of his life.*

In a serious mood, Mr. Norton's pioneering report has aroused a lot of interest. Several readers have told us they found it even more stimulating than our little pet's firewater.—ED.





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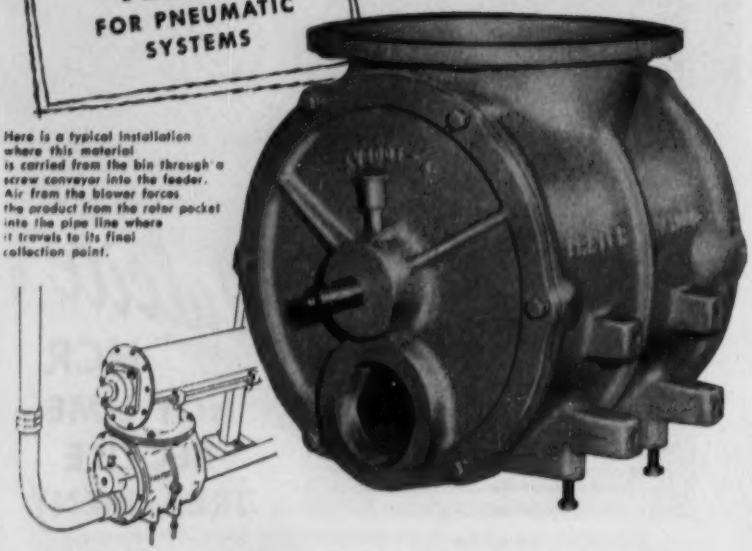

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Meet Your

Richard A. Mixer

PROTECTIVE LINING SYSTEMS. PAGE 175.

R. A. Mixer is a member of the firm of R. A. Mixer & Associates of Union, N. J. For the past year he has been a consultant in the corrosion field. He is also connected with the firms of Grassman & Kreh, civil engineers of Elizabeth, N. J., and Alexander Potter Associates, consulting engineers of New York.

In 1947 Mixer received his BS in ChE from the University of Michigan, where he earned a Masters in business administration the following year. During his graduate year he also took special courses in plastics and paint formulation.

Since his graduation, he has worked for the plastics department of Rohm & Haas Co., in Philadelphia, and for Metalweld, Inc. At Metalweld he was manager of the Protective Coatings Division where his responsibilities included supervision of sales, budget, advertising and production.

As a specialist on corrosion prevention, especially in linings, Mixer has developed a number of basic theories, as well as new methods for application of metallizing combined with organic coatings. He is a member of the National Association of Corrosion Engineers.

Mixer's home is in Summit, N. J. He is married and has three daughters. Outside working hours his interests run to amateur theatricals and to local politics.

Authors...

S. John Oechsle, Jr.

PROTECTIVE LINING SYSTEMS. PAGE 175.

S. J. Oechsle, Jr., is vice-president of Metalweld, Inc., of Philadelphia, and is in charge of that concern's Protective Coatings Division. He has been directly responsible for the operation of this division since 1953 when he was made general manager. His vice-presidency has dated since 1956.

Jack Oechsle was born in Philadelphia where he received his earlier education. Later he studied industrial engineering at Lehigh University. Following a period in the USAF where he received flight engineer training, he joined Metalweld in 1947, there starting with shop and field training and later taking over a sales territory. In 1950 he became sales manager of the company.

In his present capacity our author's duties involve complete administrative control of the Protective Coatings Division, as well as estimating and job procedure. He devotes part of his time to advertising and sales promotion but feels that the most important phases of his activities are those related to development of application procedures for coatings, and equipment for carrying out this work.

Oechsle is associated with professional groups concerned with equipment and corrosion protection, and holds memberships in the American Welding Society and National Association of Corrosion Engineers. He is active also in trade organizations in

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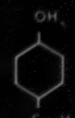

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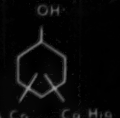

$H_{19}C_9$ C_9H_{19}

M.W. 346

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AUTHORS . . .

the equipment distribution and metallizing fields. Along non-professional lines, he is interested in yachting and is a member of the Union League of Philadelphia.

Ju Chin Chu

UPDATE YOUR REACTOR DESIGN METHOD. PAGE 215.

Ju Chin Chu is professor of chemical engineering at the Polytechnic Institute of Brooklyn. Like others who are associated with the proud Borough of Brooklyn (the Dodgers, that is), Dr. Chu's activities and reputation are not confined by any geographical boundaries.

Since 1946 he has been a nation-wide consultant on reactor design, process development and design, unit operations and applied thermodynamics.

His consulting services have been sought by chemical, nuclear, aircraft, petroleum and propellant companies. Most recently, he spent the summer as consultant to Argonne National Laboratory at Lemont, Ill.

Before he joined Polytechnic as associate professor in 1949, Chu was a technologist at Shell Chemical Corp. and assistant professor at Washington University (St. Louis). He has been professor of chemical engineering since 1955.

Chu is a prolific author, having authored or co-authored more than 45 research papers and books. His professional activities are extensive. Presently he is president of the Chinese Institute of Engineers in this country, a fellow of the AAAS, member of AIChE, ACS, API, SCI (London), ASEE, Tau Beta

Pi, Sigma Xi and Phi Lambda Upsilon.

A licensed professional engineer, Chu's biography is listed in half a dozen Who's Who's, including "Who's Who in Engineering" and "Chemical Who's Who."

Married in 1945 to Ching Chen Lee, he has three sons aged five, eight and ten. The Chu family resides in Garden City, Long Island, N. Y.

A. H. Younger

CHARTS HELP SOLVE HEAT BALANCES. PAGE 209.

A. H. Younger is a Canadian who received his early education in Vancouver, B. C. He attended the University of British Columbia where he earned his BS in ChE in 1945 and MS in 1946. At Purdue University he was awarded a PhD in chemical engineering in 1951.

Younger has devoted his time since 1951 to process and project engineering with engineering firms. For two years he was asciated with C. F. Braun & Co. as a process engineer. Then he joined W. M. Barnes in Toronto for 1½ years as a project engineer. During better than two years with Chemical Construction Corp., in both Toronto and New York, he served as both a process and a project engineer.

Younger presently is assigned to Pacific Petroleums, Ltd., Calgary, Alberta. Right now he is working in home territory on a new gas treating and refining plant at Fort St. John, B. C.

Younger is a member of the AIChE and is a registered professional engineer in the Province of Ontario, Canada. He and his wife have two small sons.

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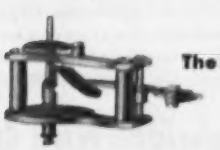

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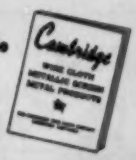

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AUTHORS . . .

Raymond Meyer

EXTRUDED GASKETS SOLVE HIGH-PRESSURE PROBLEMS. PAGE 212.

Ray Meyer has worked with pressure vessels since 1951. And he's seen all kinds from vessels used under vacuum conditions to some that are good for 13,000 psi. working pressure; from some that are used at minus 325 F. to others that can withstand 1,500 F.

After graduating from the Polytechnic Institute of Brooklyn with a BS in mechanical engineering, Ray left his native New York City and joined the Griscom-Russell Co. at Massilon, Ohio. At G-R he has been concerned with sales, design, engineering and production of pressure vessels. He is a member of both ASME and the Society for Experimental Stress Analysis.

For an engineer, Ray Meyer's hobbies may seem a bit unusual. Some time ago he authored an article on bicycle brake repairing in *Mechanix Illustrated* magazine.

However, his major leisure time activity is singing and taking singing lessons. He carries a tenor lead for two choirs in Canton, Ohio. In addition he is busy organizing a choir in Massilon that will number from 100 to 200 voices.

When not using his vocal cords—or designing pressure vessels—Ray Meyer spends his time designing furniture and model railroads, with more than a few moments for his wife, Marcia, and their 11-month old son Kevin.

Ray is a veteran of World War II and served mainly with the 20th Armored Div. in the European theater of operations.

Bernard S. Wright

CAVITATING VENTURI FOR FLOW CONTROL. PAGE 221.

Now a lieutenant junior grade in the USNR, and a gunnery officer aboard the USS Forrestal, B. S. Wright was a chemical engineer in civilian life, with a background of research and development.

After receiving his BS in ChE at New York University in 1949, Lt. Wright attended the University of Delaware where he earned his MS, also in chemical engineering, early in 1951. Immediately he joined the Eclipse-Pioneer Division of Bendix Aviation Corp., at Teterboro, N. J., remaining there for the next 2½ years prior to his naval enlistment.

At Bendix, Wright met and worked with co-author Olicker. In the course of their investigations they became acquainted with the properties of the cavitating venturi, which is apparently unknown to most people. They became convinced of the valuable possibilities of this device as a means for controlling flow irrespective of downstream pressure variations.

Until he joined the USNR in 1953, Wright's work was in research and development on small liquid propelled rocket motors. Then in Fall 1953 he was called to active naval duty, took training at Newport, and was commissioned.

Wright is single and, we understand, thoroughly enjoying his naval experiences, but is still anxious to resume civilian life and his chemical engineering activities. When he returns, he will pick up his interests where he left them, in his AIChE and ACS memberships, and in

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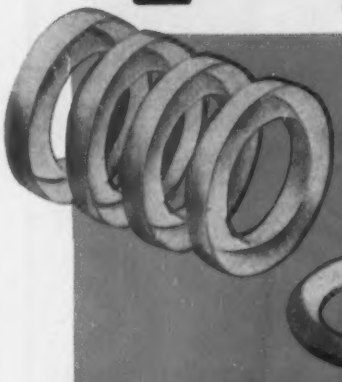

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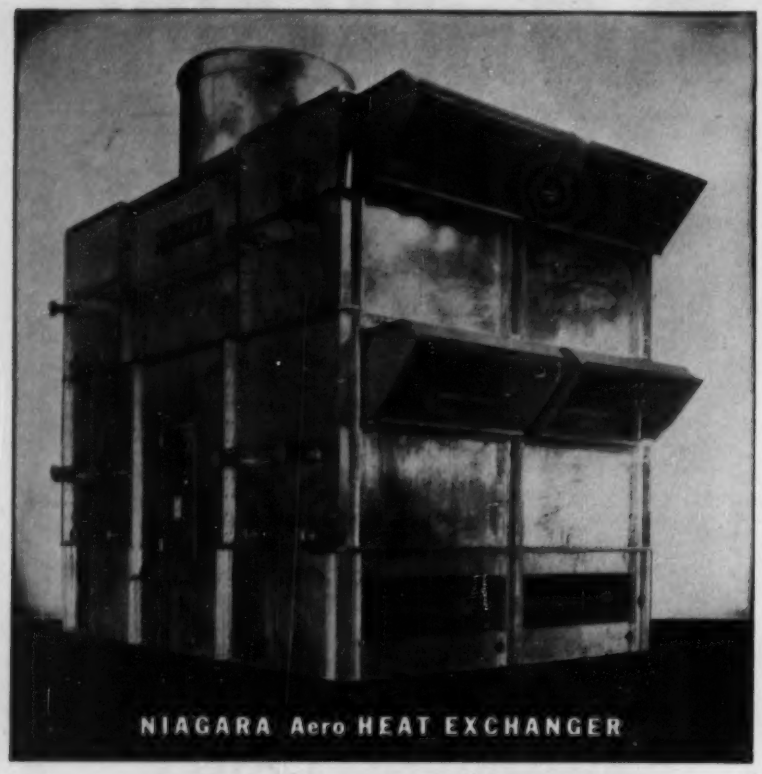

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his honorary fraternity, Phi Lambda Upsilon. And he'll also return to his preoccupation with sports, especially tennis and basketball. His co-author describes him as "athletically adept." Says Olicker, "He throws himself into a new sport with enthusiasm and becomes an expert fast. For example, when he decided to go into the Navy he undertook to learn to swim. Inside of three weeks he'd become an excellent swimmer."

Seymour D. Olicker

CAVITATING VENTURI FOR FLOW CONTROL. PAGE 221.

Lt. Wright's co-author, S. D. Olicker, is an engineer with Bendix Aviation Corp., Teterboro, N. J., where he specializes in heat transfer. Graduating in 1939 from CCNY as a BS in ChE, he worked as civilian with the U. S. Army Corps of Engineers, later enlisting in the Air Force. Following training at Yale he was commissioned as an aircraft maintenance officer and spent some two years on Air Force maintenance work in India during and immediately after World War II.

At various times since his undergraduate days, Olicker has gone back to school, taking further chemical engineering at the University of Minnesota and Brooklyn Poly. He has also studied at Syracuse and NYU and at one time was interested in obtaining a degree in education.

Since leaving the USAF, his principal professional connections have been with M. W. Kellogg Co. in Jersey City and, since 1951, with Bendix. For his present employer he has worked

on rocket research and development and, more recently, on heat transfer as it relates to the entire environmental problem in high velocity aircraft.

Married and the father of two children, Olicker often relaxes by indulging in color motion picture photography, and in music—listening, he emphasizes. He also enjoys constructing nomograms, and collecting those drawn by others.

James O. Osburn

PHYSICAL EQUILIBRIUM FOR EQUIPMENT DESIGN. PAGE 223.

Each of us yearns for that which he has not.

In Iowa, where there are no mountains, it is logical then to find a mountain-climbing club called the Iowa Mountaineers. Since the mountains won't come to the mountaineers, they must perforce go to mountains.

Jim Osburn, just past 37 and associate professor of chemical engineering at the State University of Iowa is one of the more active members of the Iowa Mountaineers. One evening this past summer he kept us spellbound for several hours at his home in Iowa City, describing some of his adventures and showing some of the most beautiful color slides that we have ever seen.

On a climbing excursion in Mexico two years ago, Jim was hurt in an accident on the slopes. It took his companions 5 hr. to bring him down to safety and medical attention. Nothing serious, he assured me—only a broken leg.

James O. Osburn took three chemical engineering degrees from the University of Mich-

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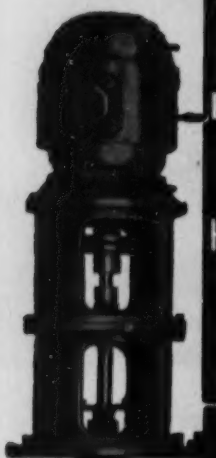

Fig. 19,488

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AUTHORS . . .

igan, the BS in 1939, MS in 1940 and PhD in 1944. While doing his graduate work he was also a working engineer with the Werner G. Smith Co. division of Archer-Daniels-Midland. During World War II he served in the U. S. Navy and in 1946 joined the chemical engineering staff at the State University of Iowa.

Jim is an active scout leader and gets plenty of opportunity to brush up on his merit badges. The entire Osburn family, including his wife Ina, two sons and a daughter are camping and climbing enthusiasts.

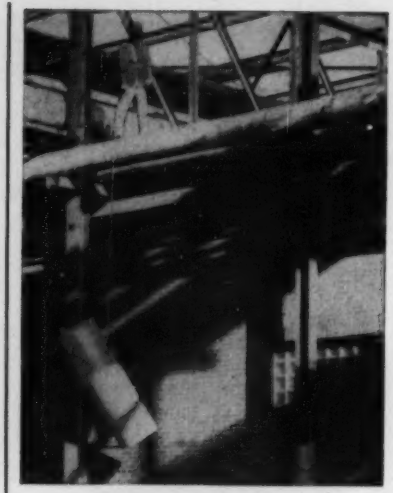
Kempton H. Roll

INSPECTING LEAD LININGS. PAGE 248.

Kempton H. Roll attended Carnegie Institute of Technology, received his BS from Yale University and his MS from the Polytechnic Institute of Brooklyn.

Long active in corrosion-control work, his activities include chairman of the 1956 Conference of the National Association of Corrosion Engineers; chairman of the American Society for Metals, N. Y. chapter; chairman of the N. Y. Powder Metallurgy Group of the American Institute of Mining and Metallurgical Engineers; chairman of the Subcommittee on Metal Powder Plants of the Dust Explosion Hazards Committee of the National Fire Protection Assn., as well as memberships in SNT, ACS, ASTM, AIChE, SAE and AOA.

At the time this article was written, Mr. Roll was technical director of the Lead Industries Assn. Presently he is executive secretary of the Metal Powder Assn.



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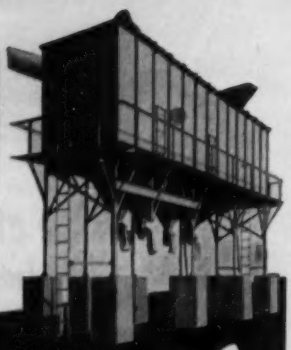

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THIS MONTH'S

Technical

Polyethylene

POLYETHYLENE. By R. A. V. Raff and J. B. Allison. Interscience Publishers, New York. 551 pages. $16.

As the authors of this latest addition to the "High Polymers" series point out, they were faced with the advisability of postponing their writing of a volume on polyethylene because of constant developments in a highly competitive field which might make part of their text obsolete and/or incomplete before it even went to press.

Their decision to go ahead, nonetheless, was indeed a wise one. For here we have the first organized form of the vast polyethylene literature—a comprehensive account of the chemistry and technology of a polymer which consistently makes chemical headlines.

The book opens with a brief chapter on historical development—starting with von Pechmann's isolation of polyethylene (1898) from decomposed diazomethane solution and continuing on through such reactions as Fischer-Tropsch synthesis, reduction of polyvinyl chloride and the more recent high-pressure and low-pressure polymerization techniques.

Next comes a discussion of ethylene monomer—its addition reactions, chemical and physical properties, manufacture, separation and recovery, purification and testing.

The three most detailed chapters, as one might expect, deal with the polymer—particularly methods of polymerization (catalysts, inhibitors, etc.), molecular structure (crystallinity, molecular weight, chain branching, etc.), properties (e.g. solubility, permeability, density, specific heat, high-density and low-molecular-weight polys).

In addition, there are chapters on modified polyethylenes, analysis and testing of polyethylenes, processing and handling, uses and applications.

In a statistical summary, the

Bookshelf

EDITED BY R. K. GITLIN

authors discuss production and consumption (from 1938 through 1954) and list foreign as well as domestic producers. Considering the constant influx of entrants into the field of polyethylene processing, the latter is remarkably complete.

True, adequate treatment of more recent developments—particularly the new low-temperature and low-pressure process—is lacking in this volume. But this is understandable. These new techniques are just beginning to operate here and abroad.

Despite this inadequacy, the book is a fine contribution to high polymer literature. It should prove a valuable aid, background text and reference for polyethylene producers, fabricators and everyone working in the field.—RKG

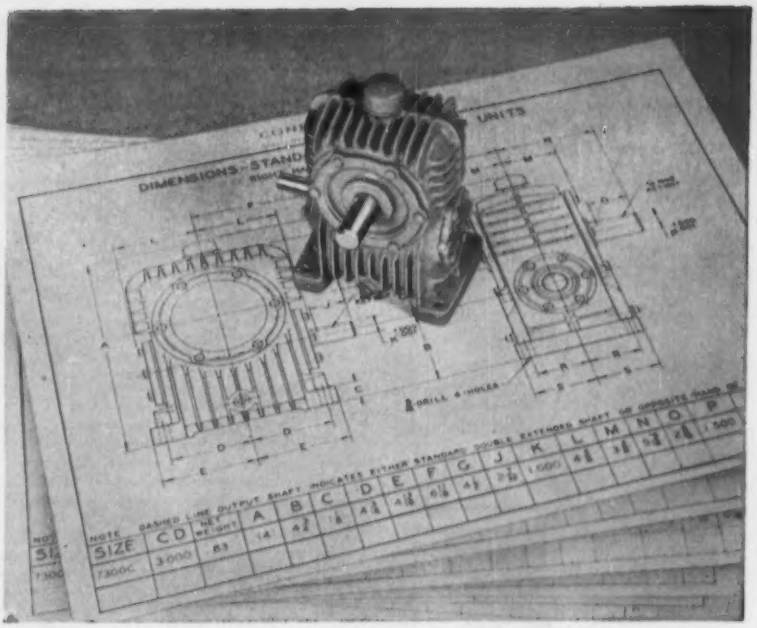
Titanium

TITANIUM. By A. D. McQuillan and M. K. McQuillan. Academic Press Inc., New York. 466 pages. $10.

Reviewed by A. E. Newkirk

Volume 4 of the "Metallurgy of Rarer Metals" provides a thorough and well-written summary of both the art and science of titanium metallurgy. The authors, who work at the University of Birmingham and Imperial Chemical Industries, respectively, bring to their task both the university and industrial viewpoint. The result: A summary of information about this rapidly advancing field that meets fully the objectives of the series—to provide a readable reference useful to the student, technologist and research worker.

The book opens with a brief chapter on the history and occurrence of titanium, followed by a more detailed chapter on its recovery from ores. Particular emphasis is given to the preparation and reduction of titanium tetrachloride. And the authors have been careful to point out



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Output Torque (inch-lbs.)	3340	3010	2830	2405	2250	2150	1940	1575

That's a lot of capacity for a unit that occupies less floor space than this magazine page. But it's typical of Cone-Drive speed reducers and gearsets. Complete details on this model in Bulletin 600-C. Other units to 800 HP and ratios to 4900:1.

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DENVER Forced-Feed JAW CRUSHER		3¼"x 3½' to 36"x 48"	Cast Steel Frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and thus increase life of heavy-duty, oversize roller bearings in bumper. Setting easily controlled. Please write for Bulletin No. C12-B12.
DENVER Wet Reagent FEEDER		0 cc to 2000 cc	Accurately meters minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Handwheel adjustment to control amount of liquid is simple and accurate. Used in multiples for higher capacities. Please write for Bulletin No. F6-B9.
DENVER Disc FILTER		1 Disc, 2' to 12 Disc, 9'	Special, patented design of segments in Denver Disc Filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Simple, low-cost, dependable construction. Quick delivery. Also Drum and Pan Filters. Please write for Bulletin No. FG-B1.
DENVER "Sub-A" FLOTATION		Laboratory and Commercial	Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. More large plants are installing Denver "Sub-A's" for their entire flotation job, because they give maximum recovery at a low cost per ton. Dependable, low-cost, simplified continuous operation. Please write for Bulletin No. F10-B81.
DENVER Wilfley Concentration TABLES		3 to 150 T/24 Hrs.	A mechanically operated, longitudinally reciprocating table consisting of a deck having a plane surface partly riffled and a tilting device. It separates materials into bands and handles the coarsest sands with excellent results. Ideal for separation of groups of particles having a similar range of specific gravities. Write for Bulletin No. T1-B3.
DENVER LABORATORY EQUIPMENT		Batch or Continuous	Batch and continuous test models of Crushers, Screens, Ball Mills, Pulverizers, Rod Mills, Classifiers, Agitators and Mixers, Pulp Distributors, Feeders, Flotation Machines, Pumps, Thickeners, Filters, Dryers, Tables, Samplers. Results obtained on Denver Laboratory Equipment can be duplicated by commercial machines. Please write for Bulletin No. LG3-B10.
DENVER Standard DRYERS		2'x 15' to 3'x 40' and larger	Available in several types: Direct Heat, Indirect Heat, and Steam Tube. Let DECO Engineers solve your drying problem. No dryer problem too small or too large. Please write for Bulletin No. D4-B2.

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the disadvantages of present methods and to suggest modifications. Rounding out the picture on preparation are excellent descriptions of the iodide process for titanium purification, melting and casting.

The rest of the book is devoted to information on the properties of titanium and its alloys. An extensive chapter reviews current information on fabrication and joining. Other chapters deal with physical properties, mechanical properties, heat treatment and mechanical properties of titanium-rich alloys, deformation mechanisms and textures, transformations in titanium and its alloys.

The chapter on the constitution of titanium alloys contains a good description of problems

Coming . . .

A quick and convenient reference for scientists, engineers, teachers and students will be a multivolume compendium of scientific and technological knowledge called "The McGraw-Hill Encyclopedia of Science and Technology."

To be completed in about three years, the encyclopedia will be made up of several thousand alphabetically arranged and cross-indexed articles, written by acknowledged authorities in science and engineering.

William H. Crouse will act as overall editor. Thirty consulting editors will select some 2,000 top specialists to write the articles. And a staff of 20 will then assemble and copy-edit all contributions, prepare the index, arrange cross references and generally do everything necessary to convert the contributions into 7,000 illustrated, oversize pages—probably bound in 10 volumes.

Through periodic article revisions and annual publication of "The McGraw-Hill Yearbook in Science and Technology," the encyclopedia will be kept up to date.

arising in constitutional studies of these systems as well as a section on the determination of phase boundaries. Thirty-eight binary systems are described, many with constitutional diagrams. And a tabulation is given of the partial studies of ternary systems which have been reported. Titanium metallography is described in a separate chapter.

Reaction of gases with titanium, the all-important problem which must be taken into account in all stages of the metal's preparation and use, is discussed with particular reference to oxygen, nitrogen and hydrogen. Also included is a review of titanium's behavior in aqueous solutions and towards common corrosive agents.

This volume is well printed and contains many excellent illustrations. The authors have succeeded in their aim of presenting a full account of the basic properties of titanium metal and its alloys as well as discussing the principles of all aspects of its industrial preparation and processing.

Briefly Noted

ASTM STANDARD ON RUBBER PRODUCTS (WITH RELATED INFORMATION). 746 *pages.* $5.75. *American Society for Testing Materials,* 1916 *Race St., Philadelphia* 3, *Pa.* Contains, in their latest forms, 158 standards—91 test methods, 38 specs, 23 recommended procedures, 6 definitions. Included are processibility tests, chemical and physical tests for vulcanized rubber, aging and weather testing, low-temperature tests. Also standards for packing and gasket materials, hose and belting, tape, electrical protective equipment, rubber-coated fabrics, insulated wire and cable, etc. Standards for latex foam, sponge and expanded cellular rubber, rubber adhesives, rubber latex and non-rigid plastics are also to be found.

NUCLEAR METALLURGY. Vol. 3. 54 *pages.* $3.75. *American Institute of Mining, Metallurgical and Petroleum Engineers, Inc.,* 29 *W. 39th St., New York* 18, *N. Y.* Deals with effects of irradiation of metals in atomic reactors. Included are articles on theory and mechanism of radiation effects in

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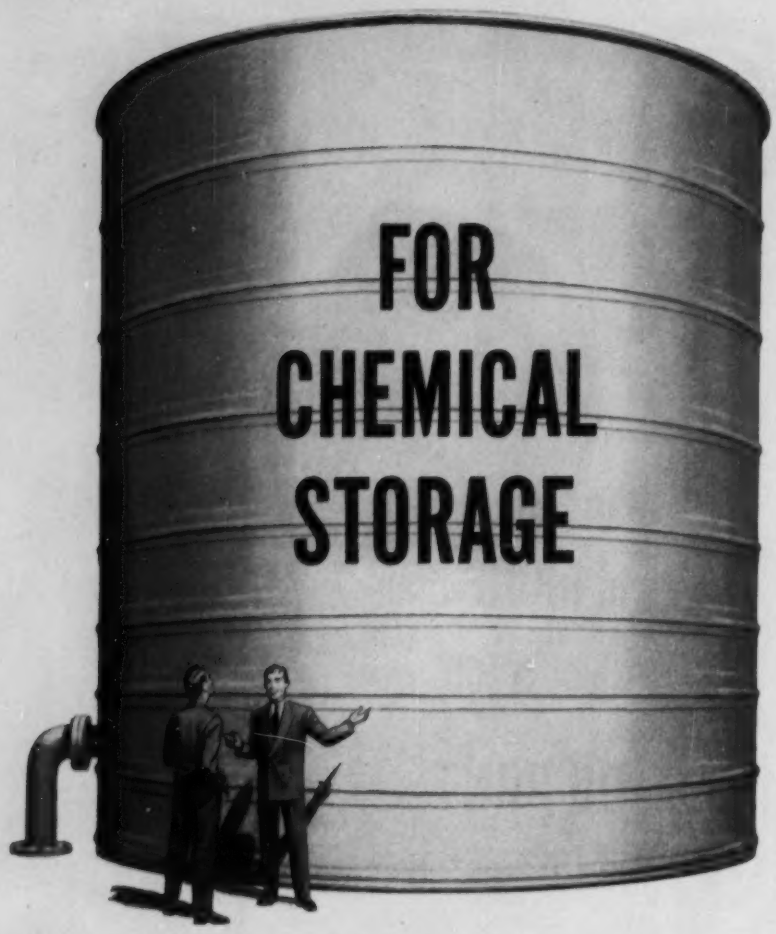

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metals, irradiation effects in physical metallurgical processes, irradiation effects in reactor materials.

OXIDATION RESISTANT SILICON-ALUMINUM STEELS. Special Report No. 2. *By E. A. Brandes. 40 pages.* $1.50. *Fulmer Research Institute, Ltd., Stoke Poges, Buckinghamshire, England.* Deals with the determination and comparison of oxidation resistance and mechanical properties of both silicon and silicon-aluminum steels.

CLASSIFICATION OF ROCKS. *By Russell B. Travis.* $1. *Dept. of Publications, Colorado School of Mines, Golden, Colo.* Designed to prevent confusion resulting from varied methods of rock nomenclature. Author names rocks on basis of visible features, using terms and conventions generally accepted at present. Included are full instructions for naming rocks (igneous, sedimentary or metamorphic), three complete reference charts, 66 photographs. For both amateur and professional geologists.

WHY D-C? 32 *pages. Direct Current Motor and Generator Dept., General Electric Co., Erie, Pa.* Non-promotional booklet on advantages of d.c., particularly with advances in automation. Covers d.c. — production and profit, d.c. drives and automation, where d.c. is being used, application areas for d.c. drives.

ORGANIZATION OF THE FEDERAL GOVERNMENT FOR SCIENTIFIC ACTIVITIES. 349 *pages.* $1.75. *Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.* Guide to complex of scientific activities of 38 federal departments and agencies. First such report in nine years to separately describe each of the government's hundreds of scientific units. Units whose activities and functions are described are engaged in the conduct, planning or administration of research and development; expansion of research and development plant facilities; testing, evaluation and standardization; training of scientific manpower; dissemination of scientific information; collection of general purpose statistics in natural and social sciences.

FISHER/TAG MANUAL FOR INSPECTORS OF PETROLEUM. 200 *pages.* $1.75. *Fisher Scientific Co., 331 Fisher Bldg., Pittsburgh 19, Pa.* Contains condensed versions of

37 test methods most used by field men in petroleum industry, most important gravity and viscosity tables, number of other reference and conversion tables. 42-gallon petroleum barrel, now standard in the U. S., has been added to table of conversion factors.

1956 SUPPLEMENT TO BRITISH CHEMICALS AND THEIR MANUFACTURERS. 35 *pages. Association of British Chemical Manufacturers, Cecil Chambers, 86 Strand, London,* W.C. 2, *England.* Annual supplement to biennial directory, latest of which was published in 1955. Provides additions and changes in list of products produced in the last year.

RECENT DEVELOPMENTS IN LABORATORY TECHNIQUE AND MEASURING AND CONTROL PRACTICE. 359 *pages. DM* 33.70 (*DECHEMA members*), *DM* 42.15 (*non-members*). *DECHEMA Deutsche Gesellschaft fur chemisches Apparatewesen, Frankfurt am Main.* No. 332-362, Vol. 27, in Dechema — Monograph Series. Contains full text of 31 discussion lectures delivered in connection with the First Congress of European Federation of Chemical Engineering and the ACHEMA XI Chemical Apparatus and Equipment Congress and Exhibition held in 1955. Includes information on laboratory technique—analytical balances, extraction methods, chromatography, mass spectrometers; measuring and control practice—flow measurement and indication, pressure and measuring transformers, gas analysis with infrared rays, etc.

RECENT DEVELOPMENT IN OPERATING AND MATERIAL TECHNIQUE. 400 *pages. DM* 36.75 (*DECHEMA members*), *DM* 45.95 (*nonmembers*). *DECHEMA Deutsche Gesellschaft fur chemisches Apparatewesen, Frankfurt am Main.* No. 363-391, Vol. 28, in the Dechema-Monograph series. Contains text of 29 lectures delivered in connection with the First Congress of European Federation of Chemical Engineering and the ACHEMA XI. Discusses operating technique—current in electrolysis, problems in heat exchange with plate apparatus with boiling two-component mixtures and in distillation plant, extraction practice, filtration questions and answers, high-vacuum technique; material technique—alloy steel castings, synthetics, synthetics reinforced with glass

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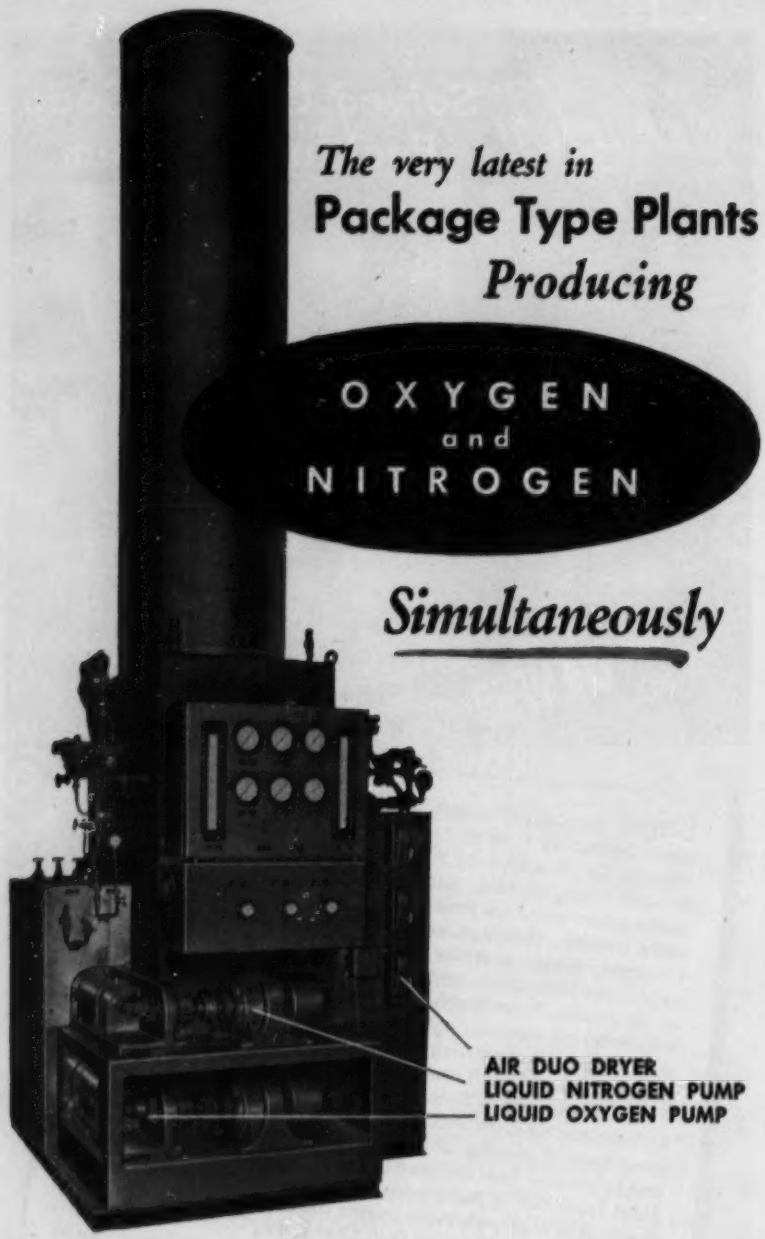

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BOOKSHELF . . .

fiber; nuclear technique—development of apparatus and equipment in connection with nuclear operations.

WOOD PRESERVATION STATISTICS 1955. *By Gordon D. Merrick.* 32 *pages. American Wood-Preservers' Association,* 839 *Seventeenth St., N. W., Washington* 6, *D. C.* Figures represent output of 317 wood preserving plants of which 319 were pressure treating plants, 78 non-pressure, 20 equipped for both pressure and non-pressure processes.

COMPILATION OF BRAKE FLUID LAWS. 36 *pages (loose-leaf).* $3.50. *Chemical Specialties Manufacturers Association.* 50 *E. 41st St., New York* 17, *N. Y.* Nation-wide summary of state government regulations pertaining to brake fluids. For guidance of those serving the automobile, truck and bus fields. Will be revised periodically to keep purchasers abreast of changing state laws.

A REVIEW OF THE AIR FORCE MATERIALS RESEARCH AND DEVELOPMENT PROGRAM. *By Mary M. Sokas.* 137 *pages.* $3.50. *Office of Technical Services, U. S. Dept. of Commerce, Washington* 25, *D. C.* Contains abstracts of 205 reports of research conducted under the Air Force's materials research and development program from July 1, 1954 to June 30, 1955. Includes information on research in adhesives, metallurgy, analysis and measurement, biochemistry, textiles, petroleum products, plastics, packaging, protective treatment, rubber.

AEC RESEARCH REPORTS PRICE LIST NO. 26. *Office of Technical Services, U. S. Dept. of Commerce, Washington* 25, *D. C.* New, free price list of AEC unclassified research reports. Cumulative listing of more than 3,000 AEC reports contains 1,034 items acquired since January 1, 1956. Price lists are issued semiannually. Next list will be available in February, 1957.

U. S. GOVERNMENT RESEARCH REPORTS. $6/*yr.* (*subscription*). *Superintendent of Documents, U. S. Government Printing Office, Washington* 25, *D. C.* Monthly publication which lists new research reports as soon as they are released by AEC. Also describes reports from the army, navy, air force and other government agencies available to the

public through Office of Technical Services.

ASTM STANDARDS ON ENGINE ANTIFREEZES. 52 *pages.* $1.50. *American Society for Testing Materials,* 1916 *Race St., Philadelphia* 3, *Pa.* Contains 11 standards—9 test methods and 2 specifications—dealing with methods for sampling, determining freezing points, physical testing, chemical testing, specifications for a hydrometer-thermometer field tester and thermometers.

FIRE AND EXPLOSION HAZARDS OF ORGANIC PEROXIDES. 60 *pages. National Board of Fire Underwriters,* 85 *John St., New York* 38, *N. Y.* Contains information on classification and evaluation of organic peroxides, application of organic peroxides, fire and explosion hazards, typical fires and explosions, precautionary recommendations. Also includes appendix on warning and emergency placard and trade name index.

More New Books

AIR POLLUTION HANDBOOK. Edited by P. L. Magill, F. R. Holden, C. Ackley. McGraw-Hill. $15.

APPLIED ELECTRICAL MEASUREMENTS. By I. F. Kinnard. Wiley. $15.

CHEMISTRY OF THE COORDINATION COMPOUNDS. Edited by J. C. Bailer, Jr. Reinhold. $18.50.

COAL-MINING. By I. C. F. Statham. Philosophical Library. $15.

COMPACT HEAT EXCHANGERS. By W. M. Kays and A. L. London. National Press. $5.

DICTIONARY OF PHOTOGRAPHY. Edited by A. L. M. Sowerby. Philosophical Library. $10.

INTERNATOINAL DICTIONARY OF PHYSICS AND ELECTRONICS. Van Nostrand. $20.

LATEX—NATURAL AND SYNTHETIC. By P. G. Cook. Reinhold. $3.50.

MAGNETOCHEMISTRY. 2nd ed. By P. W. Selwood. Interscience. $11.50.

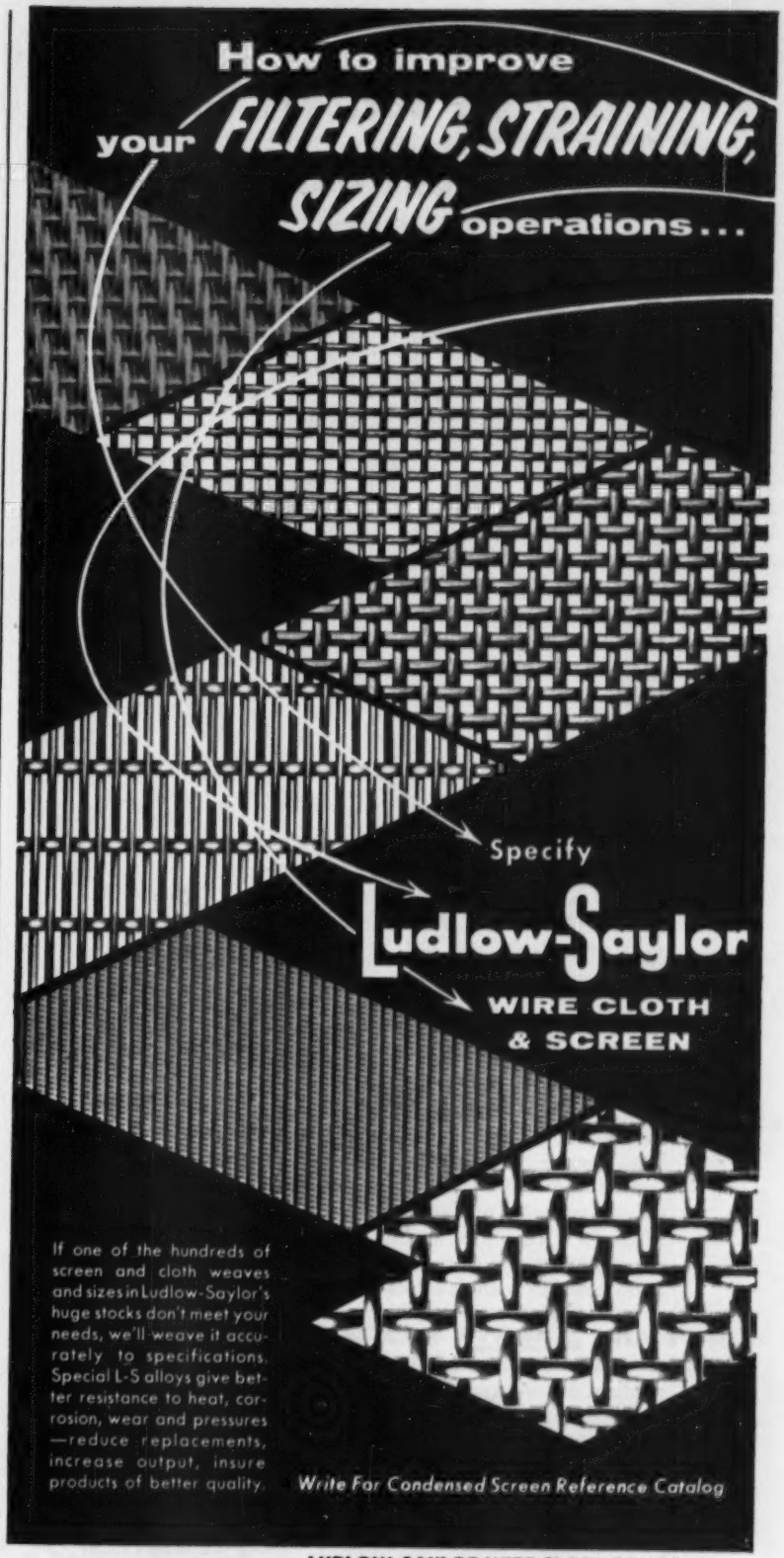
PERSPECTIVES IN ORGANIC CHEMISTRY. Edited by A. Todd. Interscience. $7.50.

POLYETHYLENE. High Polymers, Vol. XI. By R. A. V. Raff and J. B. Allison. Interscience. $16.

PROCESS CHEMISTRY. Progress in Nuclear Energy. Edited by F. R. Bruce, J. M. Fletcher, H. H. Hyman, J. J. Katz. McGraw-Hill. $12.

ROCKET PROPULSION ELEMENTS. 2nd ed. By G. P. Sutton. Wiley. $10.25.

STERIC EFFECTS IN ORGANIC CHEMISTRY. Edited by M. S. Newman. Wiley. $12.50.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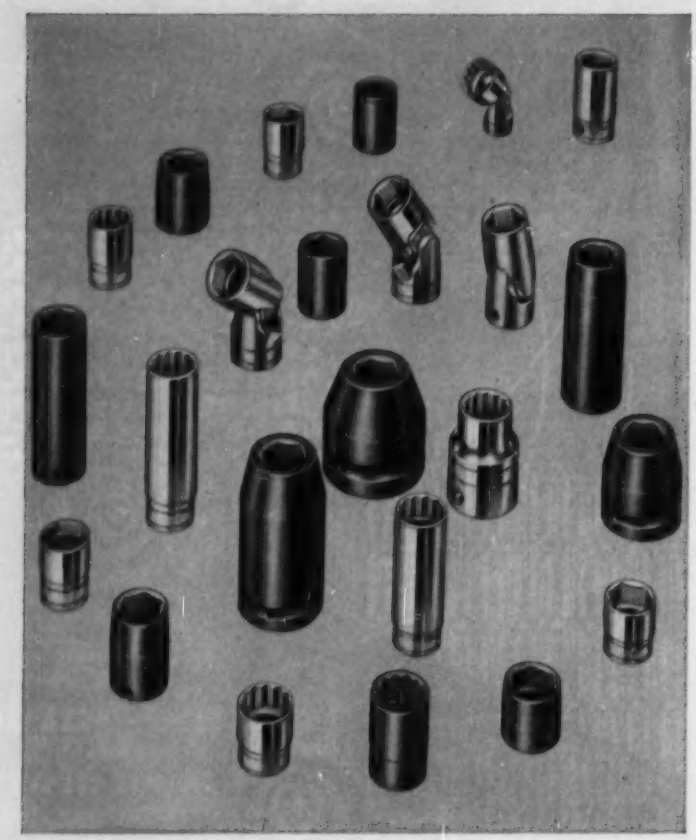

yes — AND HERE'S WHY: Every ¾-inch socket shown here solves a particular industrial nut-running problem. *Snap-on* makes this variety of ¾-inch hex wrench sockets and many more sizes and styles to give you just the one you need to match the job you have to do. Standard length, bolt clearance length, magnetic, Flexockets, power, power-impact and thin-wall types let you choose the socket to do your job faster and more efficiently, with less breakage.

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THIS MONTH'S

Firms in

NEW NAMES

Escambia Bay Chemical Corp. has changed its name to Escambia Chemical Corp.

Sharples Corp. of California has changed its name to Sharples Corp., western division.

American Brass Co. has changed the name of its Waterbury brass goods division to the fabricated metal goods division.

NEW REPRESENTATIVES

Hills McCanna Co., Chicago, has appointed Rittelmeyer & Co. sales representative for chemical metering and proportioning pumps and force feed lubricators in Georgia and eastern Tennessee.

Pennsylvania Salt Mfg. Co. has appointed Contract Engineering Co., Denver, as its agent for corrosion resistant products in Arizona, New Mexico, Colorado, Wyoming and west Texas.

High Voltage Engineering Corp., Cambridge, Mass., has added the Leybold organization, Koln-Bayental, Germany, to its foreign representatives.

Fort Worth Steel & Machinery Co., Fort Worth, Tex., has appointed Consolidated Sales Co., Mt. Pulaski, Ill., as a distributor for its mechanical power transmission and materials handling equipment.

American Gilsonite Co. has appointed Allied Asphalt & Mineral Corp. its distributor of all less carload sales of Barber gilsonite formerly supplied by American Gilsonite from its Barber, N. J., warehouse.

Ohio Injector Co. has granted U. S. and Canadian distributorship of its lubricated plug valves to the American Meter Co.

the News

EDITED BY F. ARNE

Powell Duffryn Carbon Products Ltd., Hayes, England, has appointed Delanium Graphite Co., Elizabeth, N. J., exclusive distributor in North America for its graphite block type heat exchanger.

NEW FACILITIES

Borden Co. has acquired Pioneer Latex & Chemical Co., Middlesex, N. J.

National Carbon Co. plans to build a plant near Lawrenceburg, Tenn., to make 12 million lb./yr. of carbon products.

Ultra Chemical Works, Inc., has started construction of a $500,000 plant in Chicago.

Lehigh Portland Cement Co. has started construction of a 2-million-bbl./yr., $20-million cement plant in Miami, Fla.

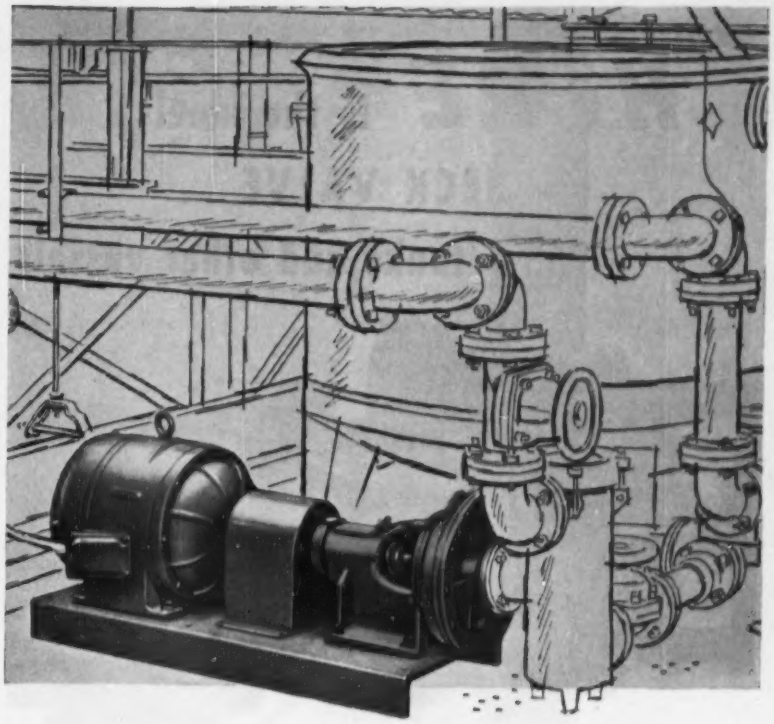
Denver Chemical Mfg. Co., New York, has purchased Hand Medicine Co. from Smith, Kline & French.

Lithium Corp. of America has acquired a 40% share in a new undertaking to exploit lithium ore resources near Pontevedra, Spain.

Farbwerke Hoechst A. G. of Frankfurt, Germany, in conjunction with Electro-Quimica de Felix S. A., Barcelona, Spain, are building a polyvinyl acetate plant in Barcelona. It will have an initial capacity of 1,400 tons/yr. of PVA in dispersion in addition to polyvinyl acetate solids and polyvinyl alcohol.

Koppers Co. has opened a new development laboratory for its chemical division to tailor make products of research to meet specific needs of customers.

Hooker Electrochemical Co. plans to build a $2-million central research laboratory at



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FIRMS . . .

Grand Island near Niagara Falls.

General Petroleum Corp. has completed negotiations to buy mineral interests in Ventura County Calif., of Santa Paula y Saticoy Oil Co., San Francisco.

Baldwin-Lima-Hamilton Corp. has opened a $3-million plant at Waltham, Mass., to house its entire electronics and instrumentation division under one roof.

Libbey-Owens-Ford Glass Co. has started up new facilities in Toledo and Ottawa which increase its capacity for making polished plate glass by conventional methods 50%.

Allied Chemical & Dye Corp. has opened a branch office in Akron for its National Aniline Div.

Phillips Petroleum Co. is building a new laboratory at its Woods Cross refinery near Salt Lake City.

Canadian Oil Refineries, Ltd., is spending $3 million at its Sarnia, Ont., plant to increase its output of octane motor fuel and produce benzene, toluene and xylene for chemical use.

U. S. Rubber Co. is spending $235,000 on a new sales branch and warehouse in Omaha, Neb.

Union Oil is building a platinum catalyst reformer-Unifiner installation at its Los Angeles refinery nearly identical to one at its Oleum, Calif., plant where the reformer has capacity of 14,500 bbl./day, Unifiner capacity: 15,750 bbl./day.

Territory Enterprises is adding to its acid-making capacity at Rum Jungle, Australia, to allow for a substantial increase in the refining of uranium ore.

Canadian government has awarded a contract to AMF Atomics (Canada), Ltd., to

produce nuclear fuel elements for its experimental atomic reactors. AMF will build a plant at Port Hope, Ont., to produce the fuel elements.

Johns-Manville Corp. will build a Transite asbestos-cement pipe plant at Denison, Tex.

Levinthal Electronic Products, Inc., is building facilities in Palo Alto, Calif., for research on high-power microwave equipment for radar, data transmission, missile guidance.

Goodyear Tire & Rubber Co. has opened a new tire and tube manufacturing plant near Valencia, Venezuela.

Rem-Cru Titanium, Inc., has acquired 262 acres in Beaver County, Pa., for possible future construction of a new research laboratory and administration offices.

U. S. Borax & Chemical Corp., has started construction of a laboratory at Anaheim, Calif., which will conduct research for three divisions of the corporation: Pacific Coast Borax Co., U. S. Potash Co., and 20 Mule Team Products.

Du Pont Co. will build a $2-million radiation physics laboratory at its experimental station in Wilmington, Del.

Standard Oil Co. of Texas is about to begin construction on a 27,000-bbl./day, $5-million catalytic cracking unit in El Paso.

American-Marietta Co. has acquired Dragon Cement Co. which operates plants in Northampton, Pa., and Thomaston, Me.

United Carbon Co. and Shell Petroleum Co. plan to build a carbon black plant in Melbourne, Australia.

American Oil Co. has put a $35-million refinery on stream in Yorktown, Va.

Stein, Hall & Co. have expanded facilities in Long Island City,

ACCURATE,
CONTROLLED,
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LUBRICATION
The New 82-V vacuum pumping unit "with dry sight feed," an exclusive Manzel development will end your liquid sight feed problems. Install them on any existing Manzel lubricator. Now — more accurate than ever . . . it will pay you to get complete detailed information on this dependable, field-proven Manzel unit.
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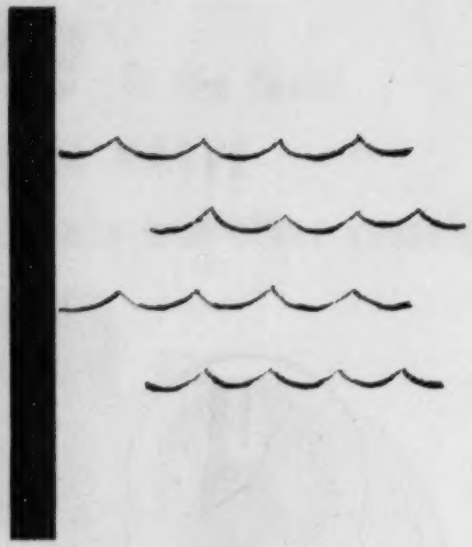
LEAD IS THE METAL THAT HEALS ITSELF!



In contact with many highly corrosive chemicals, including chromic, sulfuric, sulfurous and phosphoric acids, lead reacts instantly to form an adherent and insoluble surface film. No matter how often this skin is damaged, it re-forms automatically to give full protection against corrosion. Lead alone among metals and synthetic materials, has this inherent ability to heal itself immediately.

For piping, fittings and lining of chemical equipment, lead has other definite advantages. It is relatively inexpensive, extremely durable, pliable and malleable. It is easily salvaged and the scrap value of lead is usually a high percentage of its original cost.

Federated Research conducts a constant study of lead and its applications. Federated sales engineers can give the best possible technical help in solving your corrosive-handling or storing problems.

Write for Federated's Lead Handbook for the Chemical Process Industries. Or call any of our 12 plants and 23 sales offices if you have an immediate chemical corrosion problem.

Federated Metals

DIVISION OF AMERICAN SMELTING AND REFINING COMPANY
120 BROADWAY, NEW YORK 5, N. Y.
In Canada: Federated Metals Canada, Ltd., Toronto and Montreal

Aluminum, Anodes, Babbitts, Brass, Bronze, Die Casting Metals, Lead, Lead Products, Magnesium, Solders, Type Metals, Zinc Dust

FIRMS . . .

N. Y., to increase by 50% the company's production of formulation of galacto-mannan colloids used in paper mill applications.

Internuclear Co. of Clayton, Mo., has been awarded an AEC contract to operate a special nuclear reactor to produce gamma rays for preserving food. Production capacity may be as high as 1,000 tons/month.

Riverside Cement Co. will complete a $3.5-million plant in Los Angeles next summer which will increase its production capacity 50%.

Volunteer Portland Cement Co. plans to build a $3- to $4-million addition to its plant in Knoxville, Tenn. Production capacity will be increased 40% to 3 million bbl./yr.

Sherwin-Williams Co. has established two new overseas licensees for the manufacture of a full line of paints in Colombia and Spain. Sherwin-Williams de Colombia is completing a $500,000 facility at Fontibon. A $1-million plant has recently started up in Barcelona, Spain.

Texas Co. has acquired the Trinidad Oil Co., formerly under British ownership.

New Indria Mining & Chemical Co., Indria, Calif., has purchased Beaver Petroleum Corp. and the Laan-Tex Oil Corp.

Britalta Petroleum Ltd. of Calgary, Alberta, has acquired Wilshire Oil Co. of Texas.

Sinclair Research Laboratories, Harvey, Ill., has started building a special laboratory for studies on the effect of atomic radiation on petroleum processes and products.

National Cylinder Gas Co. has started construction of a plant in Newport, Tenn., to produce chemicals for use in cosmetics, automotive finishes, pharmaceuticals and plastics.

American Cyanamid Co. has opened a new plant for liquid alum production at Plymouth, N. C.

John W. Bolton & Sons, manufacturers of machinery and stock preparation equipment, have started building a pulp and paper research center in Lawrence, Mass.

Crown Zellerbach Corp. plans to build a $4-million multi-wall bag plant at Bogalusa, La.

Allied Chemical International Corp. has formed a new branch office in Mexico City, Mexico.

Montana Sulphur & Chemical Co., Billings, Mont., has started up a $500,000 plant to turn out 40 long tons of high-grade sulfur daily.

Dow Chemical of Canada, Ltd., has opened a sales office in Calgary, Alberta.

Prairie Pipe Mfg. Co. plans to start up a plant in Regina, Sask., next April to produce 75,000 tons/yr. of steel pipe for collection, transmission and distribution of natural gas and collection and distribution of oil.

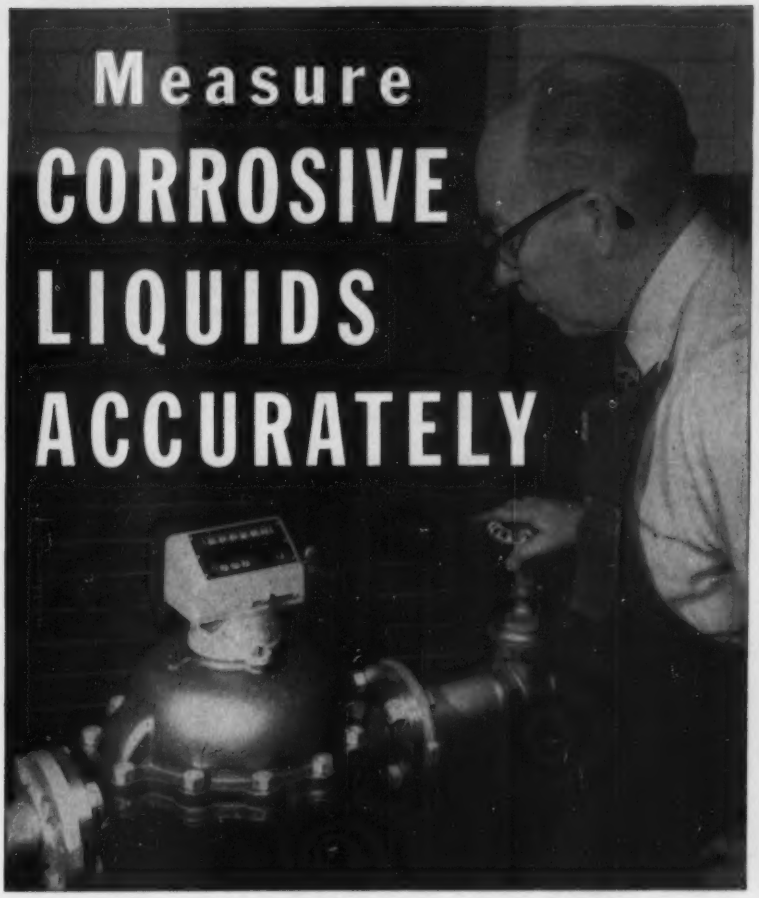
Treesdale Laboratories, Mars, Pa., has bought the Pittsburgh Metals Purifying Co., Pittsburgh, Pa., which produces exothermic compounds and fluxes for the metals industry.

Seamless Rubber Co., New Haven, Conn., has acquired the Kraloy Plastic Pipe Co., Los Angeles.

Spencer Chemical Co. will complete a $120,000 expansion of its formaldehyde production facilities in Chicago early next year.

Canadian Industries, Ltd., is building a plant in the Seven Islands area, Que., to make blasting agents. It will be completed early in 1957.

Chesebrough-Pond's, Inc., has purchased Seeck & Kade, Inc.,



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Now you can apply the extreme accuracy of Niagara Meters to the measurement of corrosive liquids. Niagara Chemical Meters of Type 316 stainless steel offer good resistance to corrosion and can be used to measure caustic soda, most acids, fruit juices and similar liquids. Available in sizes 3 to 110 G.P.M. or in intermittent use up to 160 G.P.M. Niagara Chemical Meters are also available for automatic liquid measurement and liquid flow control in hazardous or non-hazardous atmospheres.

If you have corrosive liquid metering problems, let us help you. Mail coupon today.

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BUFFALO 14, NEW YORK

Please send me information on the complete line of Niagara Meters.

Liquid.....

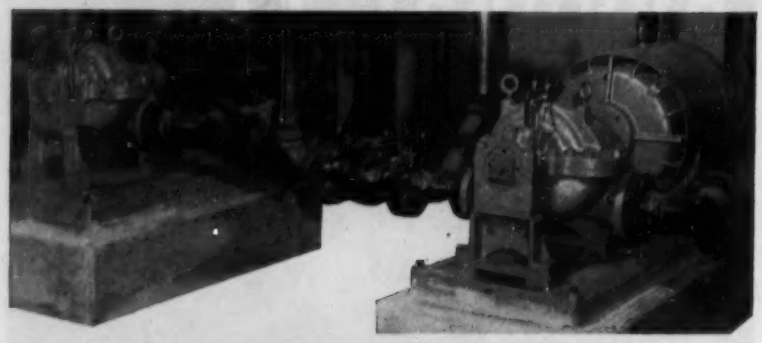
Flow g.p.m..... Temp.....°F

Name.....

Company.....

Address.....

They needed pumping capacity



They needed pumping pressure

You can have capacity . . . or pressure . . . or both

You can meet an exceptionally wide range of pumping needs with just two types of Goulds pumps.

For volume pumping—33 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6400 GPM, heads up to 425 ft.

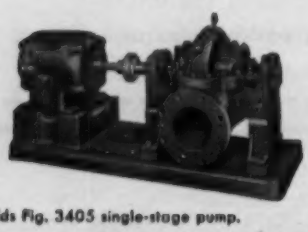
For great pressure—5 sizes of the Fig. 3305 two-stage pump provide heads up to 1000 ft., capacities to 1200 GPM.

All these *extra* features are *standard* on both groups:

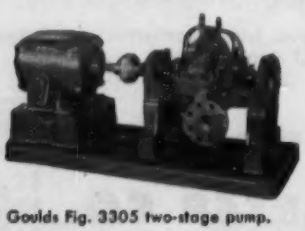
1. Bearing housings sealed against dust and moisture.
2. Renewable stuffing box bushings.
3. Die-formed stuffing box packing.
4. Cowl-type glands for use with quenching fluids.
5. Corrosion resistant gland bolts.
6. Stainless steel impeller rings.
7. Teflon water seal rings.

Because so many parts on these pumps are interchangeable—you can cut parts inventory in two or better.

For further information write for Bulletin 721.6 on the Fig. 3405; Bulletin 722.6 on the Fig. 3305.



Goulds Fig. 3405 single-stage pump.



Goulds Fig. 3305 two-stage pump.

Goulds PUMPS INC. Seneca Falls, New York

SALES OFFICES: Atlanta • Boston Chicago • Houston • New York Philadelphia • Pittsburgh • Tulsa

FIRMS . . .

makers of Pertussin cough syrup.

A. C. Horn Co. of Texas plans to build a plant in Houston to make paints and construction and building maintenance materials.

American Oil Co. is building a second large, 21,000-bbl./day Ultraformer at its Texas City, Tex., refinery.

A. E. Staley Mfg. Co. has opened a New York office to handle refined oil sales in the metropolitan area.

Minneapolis-Honeywell Regulator Co. has brought a plant in Boston to house its transistor division which is scheduled for transfer from Minneapolis.

Reeves Bros., New York textile manufacturer, has acquired the Vi-Plax Corp., Beverly, N. J., and the Garrison Co., South Plainfield, N. J., both extruders of plastic materials.

Steel Co. of Wales has started up a $3-million, 100-ton/day tonnage oxygen plant at its Abbey works.

Central Farmers Fertilizer Co., Chicago, will commence construction in the spring of 1957 on its $10-million phosphate mine, electric furnace and dicalcium phosphate plant at Georgetown, Idaho.

B. C. Forest Products has started construction of a 425-ton/day, $38.5-million bleached sulfate mill on Vancouver Island.

B. F. Goodrich Canada Ltd. is making a $400,000 addition to its plant at Kitchener, Ont., to double output of rubber lined tanks and rubber covered rolls.

Chemagro Corp., New York, will build a $2-million plant in Kansas City to manufacture agricultural chemicals.

Ideal Cement Co. has incorporated a Canadian subsidiary, Ideal Cement Co., Ltd., with

headquarters at Vancouver, B. C.

Flintkote Co. has started construction of a $1-million plant in North Judson, Ind., which will increase by more than 50% its production of fireproof building material used for ceilings, interior sheathing and structural insulation.

Sequoia Process Corp., manufacturer of plastic-insulated wire and cable at Redwood City, Calif., has opened an eastern sales division at Newark, N. J.

Dow Chemical Co. has completed a new $200,000 acrylonitrile purification unit at Midland, Mich.

Carbide & Carbon Chemicals Co. is expanding its facilities for the production of hydroxyethyl cellulose at Niagara Falls.

Minnesota Mining & Mfg. Co. has bought Zenith Plastics Co., Gardena, Calif.

Mellon Institute has established a department of radiation research to carry on a major research effort in the field of peaceful atomic energy applications.

Harry Miller Corp. has increased production at its Philadelphia plant of chemical products, oils and greases used by the metalworking, paper, plastic and other industries.

Foote Mineral Co. has started a $500,000 program at its Kings Mountain, Tenn., plant to improve plant efficiencies and enlarge office, laboratory and shop facilities.

General Latex & Chemical Corp., Cambridge, Mass., has opened a plant at Brampton, Ont.

Denver General Hospital is establishing a poison control center to help doctors in giving emergency treatment to poison victims. Thousands of industrial, household and

YOURS FOR MOST ANY GATE VALVE SERVICE

...The advantages of DARLING fully revolving disc design!

Darling Victaulic end gate valves are made in accordance with specifications to fit standard Victaulic couplings... just one of the many various types of ends offered by Darling to meet your specific installation requirements.

THE Darling *fully revolving, double disc, parallel seat* principle simplifies gate valve operation and cuts maintenance and replacement costs.

Darling offers this type of gate valve in sizes and alloys for practically any service you can name.

Regularly available in iron body, cast steel, rubber lined iron body, all bronze and special alloys . . . for ordinary and unusual services. Made with various type ends to meet your particular installation needs.

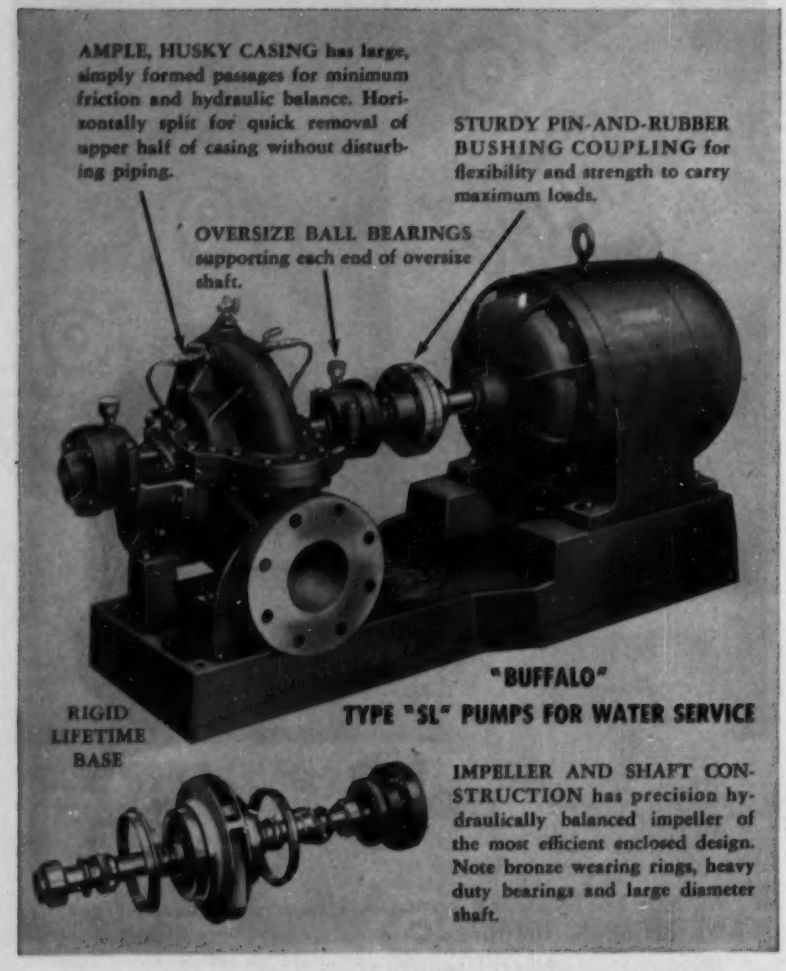
Write for complete information on Darling Gate Valves . . . the valves that give you the most dependable, maintenance-free valve service you've *ever* had.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING VALVES

BUILT-IN ENDURANCE

KEEPS YOUR PUMPING COSTS DOWN!


AMPLE, HUSKY CASING has large, simply formed passages for minimum friction and hydraulic balance. Horizontally split for quick removal of upper half of casing without disturbing piping.
STURDY PIN-AND-RUBBER BUSHING COUPLING for flexibility and strength to carry maximum loads.
OVERSIZE BALL BEARINGS supporting each end of oversize shaft.
"BUFFALO"
TYPE "SL" PUMPS FOR WATER SERVICE
RIGID LIFETIME BASE
IMPELLER AND SHAFT CONSTRUCTION has precision hydraulically balanced impeller of the most efficient enclosed design. Note bronze wearing rings, heavy duty bearings and large diameter shaft.

These are a few of the "Q" Factor* design and construction details that mean money-saving efficiency, long life and low-cost maintenance when these "Buffalo" Double Suction Pumps are on your water jobs. Write for Bulletin 955-R for the full story of this better pumping value.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo" PUMPS

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE CO.

501 Broadway Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

FIRMS . . .

pharmaceutical compounds which are poisonous will be recorded with their antidotes in a master file system.

American Hospital Supply Corp., Evanston, Ill., has acquired Dade Reagents, Inc., Miami, Fla.

B. T. Babbitt, Inc., manufacturer of household cleaning products, has acquired Chemicals, Inc., of San Francisco which makes similar products.

Warner-Chilcott Laboratories have inaugurated a division of veterinary medicine which will market several new company-developed drugs.

Du Pont Co. plans to build a $2-million radiation physics laboratory in Wilmington.

UBS Chemical Corp., Cambridge, Mass., has just started up a $400,000 extension of its polymer emulsion plant.

Monsanto Chemical Co. has added to its production capacity for fortified rosin size used in paper production with a new manufacturing facility at Fieldsboro, N. J.

Goodyear Tire & Rubber Co. has opened a new $80,000 rubber development laboratory in Akron.

Denney Logging Co. Ltd. of California will build a $1.5-million plywood mill at Fort Fitzgerald, Alberta.

Andean Cement Co. expects to put a $4.1-million, 83,000-ton/yr. cement plant into operation by the end of next year in Tarma, Peru.

American Aniline Products, Inc., plans to build a new metropolitan sales office and laboratory at Paterson, N. J.

Rockwell Mfg. Co. has opened a gas meter research and development laboratory in DuBois, Pa.

Portland Cement Assn. has opened a new regional office in Los Angeles and new dis-

trict offices in Baltimore, Trenton, Portland, Me., and Louisville.

Humble Oil & Refining Co. will install a new fluid catalytic cracking unit with a design capacity of 55,000 bbl./day total feed at its Baytown, Tex., refinery.

American Machine & Metals, Inc., has acquired Filtration Engineers, Inc., Newark, N. J., manufacturers of continuous rotary vacuum filters.

Tennessee River Pulp & Paper Co. will build a new kraft pulp and paper mill near Sheffield, Ala. To be completed late in 1959, it will have an annual capacity of 200,000 tons of linerboard and corrugating medium.

Republic Steel Corp. has announced an $8-million program for boosting its titanium melting, preparation, forging and laboratory facilities at Canton and Massillon, Ohio.

University of Colorado, Boulder, Colo., plans a new $2-million engineering building, a $1.9-million chemistry building and a $518,000 addition to its physics building.

NEW LOCATIONS

Dust Suppression & Engineering Co., manufacturers of wet type dust collectors, has moved its office to 120 South Broadway, Lake Orion, Mich.

Western Gold & Platinum Co. has moved to Belmont, Calif.

U. S. Radium Corp. has moved its general offices to Morristown, N. J.

Lincoln T. Work, consulting engineer, has moved to 36 West 44th St., New York.

International Rustproof Corp. of Cleveland has moved to 1575 Merwin Ave.

Carbide & Carbon Chemicals Co. has moved its textile fibers department to 100 East 42nd

AUTO-LITE

TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.

Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
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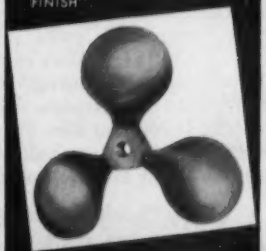
TEMPERATURE RECORDERS

SAVE TIME· SAVE MONEY

STYLE SSP
No. 304 stainless steel[2] plate welded to stainless steel hub, polished completely to "Dairy FINISH"



STYLE HX
No. 1010 steel plates welded to hexagon hub. Thoroughly suitable for all applications in which iron or cast steel propellers would otherwise be used.

with MICHIGAN'S NEW *and radically different* "FABRICATED" PROPELLERS!

NOW, for the first time in history, you can obtain "fabricated" propellers so accurately balanced and pitched they will do a perfect job of mixing, blending, stirring, pumping or aerating in any application requiring relatively low horsepower and not over 1750 RPM. Our very specialized, recently developed process of fabricating these wheels results in real cost-savings, considerably lower prices to our customers and far quicker deliveries. They are available in all standard sizes from 6" thru 24" diameters, right and left turning . . . in stainless steel polished to a "Dairy Finish" and 1010 Steel. If you are using wheels in these categories by all means investigate the new MICHIGAN FABRICATED PROPELLERS. It's bound to pay you big dividends in time and money savings. Write for your free copy of our new INDUSTRIAL PROPELLERS CATALOG.

MICHIGAN WHEEL CO.
GRAND RAPIDS 3, MICH.

"See, Dave, this is the water distribution system Pritchard uses . . ."

". . . and there are plenty of advantages to it."

"What kind of advantages, Al?"

"This redwood box flume is closed in so that no airborne dirt and debris can fall into the system and clog up the water flow. See how the system is *under* the eliminators?"

"Under or over—what's the difference?"

"Algae! One of the worst enemies a cooling tower can have! Put water and sunlight together and you've got trouble—even with good water treatment. Here, we have no sunlight reaching the water, so we have less algae, less maintenance and less treatment of the cooling water."

"Sounds good! Aren't those distributors different?"

"Yes. They're down-spray gravity type. And they're self-cleaning. Notice how the orifice and splash plate are in permanent alignment. Just one more thing! Notice how Pritchard has provided a handy, removable plug at the end of each lateral for easy inspection or flushing of the entire system."

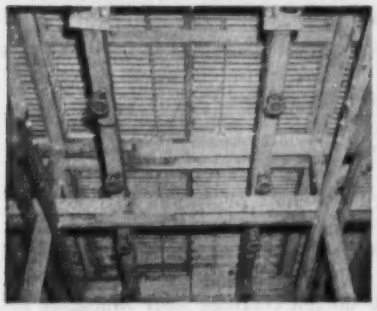
"Looks like this Pritchard tower is going to give us many years of good service."

"Yes, it looks that way to me, too!"

J. F. PRITCHARD & CO. OF CALIFORNIA
4625 Roanoke Parkway, Kansas City 12, Mo.

"See, Dave, this is the water distribution system Pritchard uses . . ."

The closed distribution system is just one more reason to choose Pritchard Cooling Towers



The Pritchard cooling tower distribution system is superior in design and performance. Just look at these features and judge for yourself!

1. Closed Clear All Heart redwood box flume, low pressure type, corrosion-free, long-lasting.
2. All members designed and securely bolted and fastened to withstand hydraulic heads well in excess of design needs.
3. Patented water distributors — incorporating integrally cast orifices and splash plates.
4. Distribution system designed to maintain dirt and debris in turbulent flow, keeping the system clean.
5. Removable flume covers and plugs at ends of all laterals for easy inspection and flushing.

Pritchard industrial cooling towers meet or exceed new Cooling Tower Institute standards.

WRITE FOR PRITCHARD COOLING TOWER BROCHURE!

Write today on your company letterhead for your complimentary copy!

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J.F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept 545, 4625 Roanoke Parkway
Kansas City 12, Mo.

COOLING TOWERS • GAS & AIR TREATING EQUIPMENT
REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

FIRMS . . .

St., New York. However, mail should still be addressed to 30 East 42nd St.

Standard Scientific Supply Corp. has moved to 808 Broadway, New York.

Food Machinery & Chemical Corp. has moved the commercial development activities of its Westvaco chlor-alkali division to South Charleston, W. Va.

Petroleum Chemicals, Inc., has moved its office to 806 Perdido St., New Orleans.

Boyco Ltd. has moved its offices and plant to 40-11 23rd St., Long Island City, N. Y.

NEW COMPANIES

Montrose Mexicana S. A. has been formed in Mexico to produce chlorine, caustic soda, monochlorobenzene, chloral and DDT at a plant to be built in Irapauto. Montrose Chemical Corp. of California will be part owner.

Fireye Controls Co., Ltd., has been formed in London to manufacture combustion safeguards and control systems at a plant in Croydon, England.

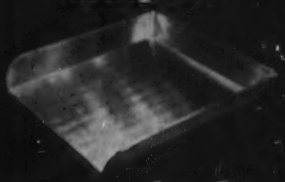
Amoco Chemicals Corp. has been formed via the consolidation of three chemical subsidiaries of Standard Oil (Ind.): Hidalgo Chemical Co., Pan American Chemical Corp., Indoil Chemical Co.

Harshaw Chemicals Ltd. has been established as a wholly-owned English subsidiary of Harshaw Chemical Co., Cleveland.

Panellit Service Corp., a new subsidiary of Panellit, Inc., will take over the activities of the parent company's instrument services division.

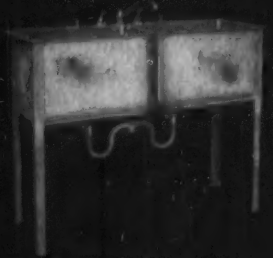
Magcobar de Venezuela, C. Z., a new Latin American affiliate of the Magnet Cove Barium Corp. will mine, process and distribute the parent company's line of oilwell drilling mud additives.

simple?

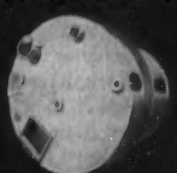


complex?

Littleford



fabricates it

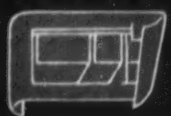


better . . . faster

and cheaper!

send us your blueprint for prompt estimate

FABRICATORS OF PLATE AND SHEET METAL PRODUCTS FOR INDUSTRY SINCE 1882



LITTLEFORD

LITTLEFORD BROS., INC.
421 E. Pearl St. Cincinnati 2, Ohio

THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

What Can Be Done About It?

There is no easy or quick way to overcome the shortage of scientists and engineers that has become a threat to our national security and economic progress. The solution can come only through diligent efforts extending over several years to bring the supply of technically trained people into balance with our needs. Meanwhile, the pressure of the shortage can be relieved if industry, government and education make better use of the limited number of scientists and engineers now available.

Earlier editorials in this series have discussed the dimensions of the shortage of technical manpower, its meaning for our national security and our economic well-being and the causes of the shortage. This final editorial will survey some of the measures that can be taken to overcome the shortage. Most of the proposals presented here have been suggested elsewhere. But in combination they appear to offer the best hope of an answer to this serious national problem.

Soviet Methods Not For U. S.

It is clear that no crash program, inspired by panic and designed indiscriminately to drive hordes of high school students into science and engineering, is suitable for the United States. Even if we adopted Soviet methods of channeling a large portion of our brightest young people into technical fields, it would be at least four years before results appeared in the volume of college graduates. And such an approach would do no credit to the American way of life.

Any crash program, whether it involved totalitarian methods or simply overselling the advantages of technical careers, would be objectionable for other reasons as well. It would jeopardize the quality of scientific and engineering training. It would put many young people in fields where they have little aptitude and deny them to other fields for which they are better equipped. And, if carried too far, it might even result in the overcrowding that was feared prematurely a few years ago.

The most important problems for the long run, as the preceding editorial in this series indicated, are in the area of education. Any real solution must reduce the loss of talented high school graduates who do not continue their education for financial reasons or because of lack of interest. Also, it must improve the quality of high school preparation in science and mathematics and, above all, relieve the critical shortage of teachers.

Basic Needs in Education

Substantial increases in salaries of teachers in most of the nation's school systems are essential if high school students are to receive adequate preparation for courses in science and engineering. Pay scales that have lagged behind rising living costs and salaries available in industry have placed great strain on even the most devoted teachers. There has been a sharp drop in the number of new graduates trained to teach science and mathematics, and of this smaller number many have decided not to follow careers in teaching.

Raising teachers' salaries to more realistic levels must be primarily the job of local school districts, aided by state governments. If, in face of rapid increases in school enrollments, local and state resources prove insufficient, then federal aid will have to be considered. Higher teachers' salaries, however financed, inevitably mean higher taxes. But without appreciable improvement soon, the quality of our entire educational system is in danger.

At the college level also, financial aid is needed to provide scholarships for promising students and to increase faculty salaries. (An earlier series of editorials dealt more fully with these problems, and business aid to higher educational institutions has been mounting at a gratifying rate.)

But not all the educational problems related to the shortage of scientists and engineers can be solved with money. Science and mathematics have steadily been de-emphasized as more youngsters have gone to high school for terminal education rather

How business is helping to relieve the shortage of technical manpower

Summary of a Survey by McGraw-Hill Correspondents

- Sponsoring summer study programs for high school teachers
- Arranging cooperative work-and-study programs for students
- Sponsoring college fellowships and scholarships in science and engineering
- Paying tuition of employees taking science and engineering courses
- Keeping college faculties abreast of new developments in industry
- Hiring high school science teachers for summer and part-time work
- Giving old, but usable, laboratory equipment to schools
- Cooperating in high school science exhibits
- Sponsoring regional science fairs
- Sending speakers and training aids to schools
- Opening plants for student tours
- Analyzing jobs to relieve engineers and scientists of routine work

The McGraw-Hill Department of Economics will be glad to hear of any other ways business is helping relieve the shortage.

than for college preparation. This de-emphasis must be reversed.

Techniques of instruction, furthermore, can stand improvement at all levels of education. Professor E. P. Northrup of the University of Chicago observes: "In the past fifty years . . . there has been a revolutionary change in the character of mathematics, yet not a trace of this change is to be found in the curricula of all but a handful of secondary schools throughout the country." Colleges and universities may have to examine old fetishes about light teaching loads and small classes in order to make more efficient use of their faculties.

What Industry Can Do

Industry has the immediate problem of better utilization of available technical manpower and the long-range responsibility of helping increase our resources of trained people. Frantic recruiting practices and reckless bidding up of starting salaries—financed largely by government money for defense orders — are not the answer. There is need for earnest consideration of incentives for experienced scientists and engineers, who too often must look to sales or executive positions for adequate financial recognition.

Industry in many instances could make more efficient use of engineers and scientists by shifting work to technicians, clerical personnel and even machines. One company found that 15% of the time of an engineering design group was spent on routine jobs and that this valuable time could be saved by adding a technician and a clerical worker to the group.

Other potential sources of technical manpower could be tapped more extensively to relieve the shortage. Very few women have entered what has been traditionally a man's world. Negroes are only slowly gaining educational and employment opportunities in technical fields. And many experienced older men can still give useful service.

A Good Beginning

Much is being accomplished already in efforts to attract more young people into scientific and engineering careers. A summary of some of the things business is doing is presented above. Other notable contributions are being made by such organizations as the professional engineering and scientific societies (especially through their manpower commissions), the National Science Foundation, the National Research Council, the National Education Association, the National Merit Scholarship Foundation and the Thomas Alva Edison Foundation.

Results are beginning to appear in rising enrollments in engineering schools and technical institutes. Between 1951 and last year, according to McGraw-Hill's annual survey of technical institutes, enrollments in these schools rose from 46,000 to a record 67,000. Engineering enrollments rose in the same period from 166,000 to 243,000. A rising tide of graduates is already being made available to American industry.

This is a good beginning. But only with wider appreciation of the serious implications of the shortage of scientists and engineers and intensified efforts on the part of business, government and education to relieve the shortage can we hope to overcome this threat to our national security and economic well-being.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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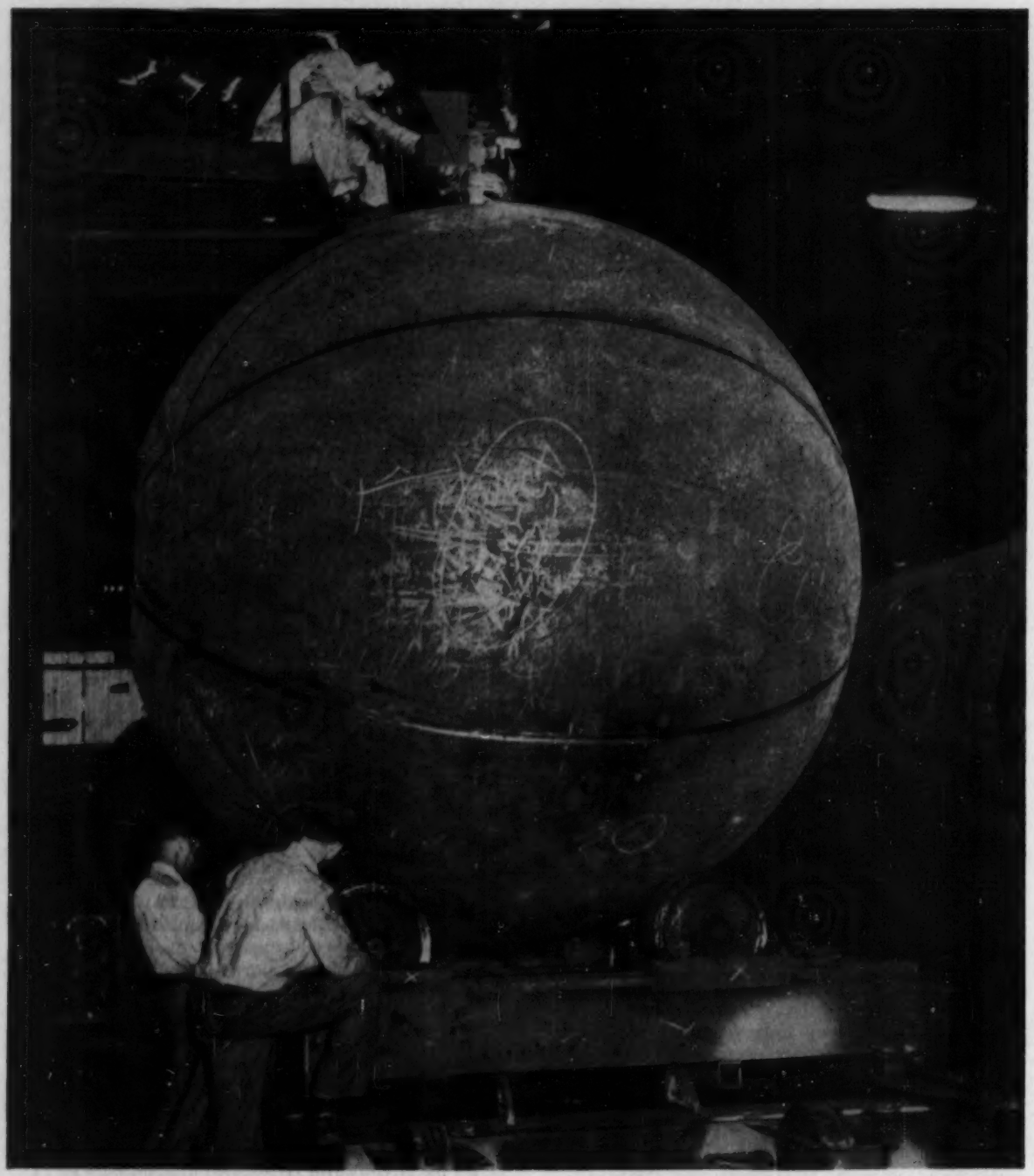

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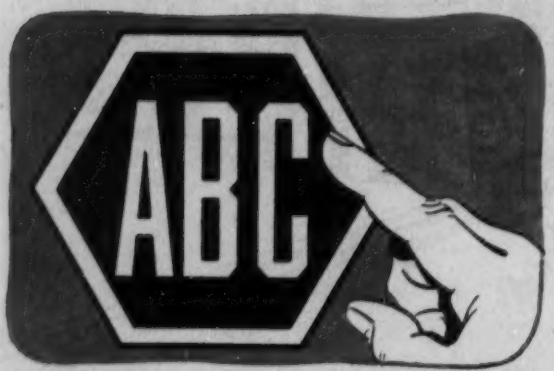

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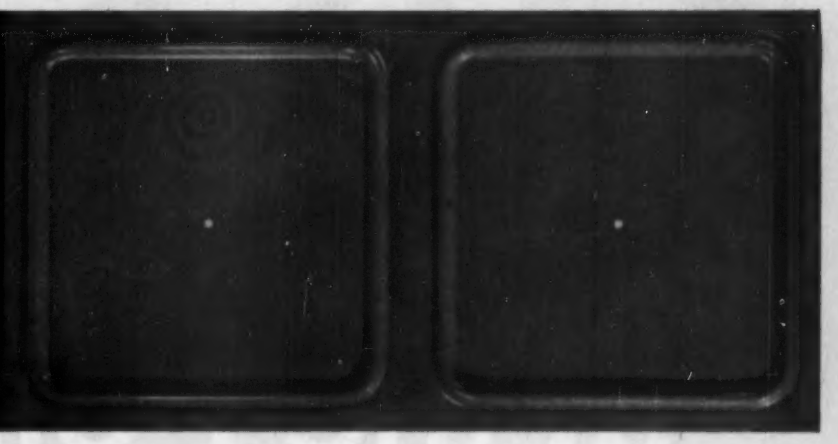

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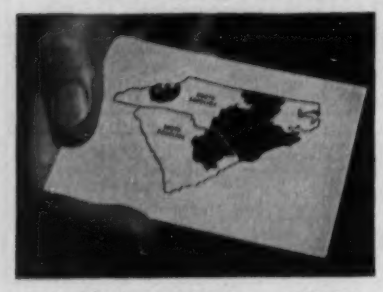

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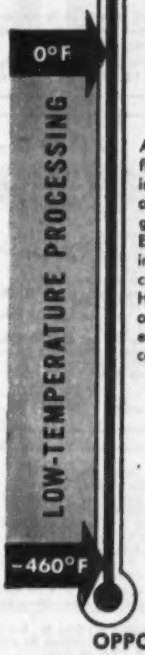

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We also need engineers who are interested in applying the principals of thermo dynamics, fluid flow, heat and mass transfer, vapor-liquid equilibria, etc. to the solution of complex new problems in low temperature technology including distillation, adsorption, absorption, physical property experimentation, analytical methods and instrumentation, process development, pilot plants, equipment development including process apparatus and machinery items such as turbines, pumps, expanders, compressors and many other interesting and classified projects.

ESSO ENGINEERING IS EXPANDING

CHEMICAL ENGINEERS NEEDED

Career openings available in long range expansion program. Work involves process planning, economics, design, and occasional field follow-up.

Prefer men of high scholastic rating and with one to seven years experience. There are also a number of openings for very recent graduates. Both Bachelors and Masters degree positions are available. Salary commensurate with experience and qualifications.

If you are interested in an opportunity for growth and promotion with a leader in the petroleum industry, write today giving full details of education, experience, salary desired, availability date and references.

All inquiries will be considered promptly and held confidential.

ESSO
RESEARCH AND ENGINEERING COMPANY

ESSO RESEARCH CENTER
EMPLOYEE RELATIONS-C

P. O. BOX 51
LINDEN, N. J.

EMPLOYMENT OPPORTUNITIES

(Continued from page 449)

PROJECT LEADER
Chemical Engineer

A challenging position is open for an experienced Chemical Engineer to act as project leader. This position is concerned with pilot plant design, construction, and operation.

This position requires a man with a degree in Chemical Engineering and extensive experience in moderately high pressures. You may use your initiative and creative ability and work with other leading scientists in this field.

We offer excellent employee benefits, opportunity for advancement, and a good salary. Please send resume to:

Mr. J. A. Metzger
ARMOUR RESEARCH FOUNDATION
of
Illinois Institute of Technology
10 West 35th Street
Chicago, Illinois

ENGINEERS

HEAT EXCHANGER and PRESSURE VESSEL ENGINEERS

Degree plus 5 years' minimum experience on heat transfer equipment and pressure vessel design of equipment used in oil refinery or chemical plants. Rapidly expanding engineering firm with long range outlook. Good salaries and excellent working conditions. Write giving qualifications to:

CATALYTIC
Construction Co.
1528 WALNUT STREET
PHILA., 2, PA.

CHEMICAL OR SANITARY ENGINEER

Executive opening for sales-minded engineer in rapidly growing department of nationally known, well-established equipment manufacturing engineers. Experience with paper or refinery industry or consulting firm desirable but not essential. Location: New York City headquarters. Our employees know of this advertisement. Send resume in complete confidence to:

P-3113, Chemical Engineering
Class. Adv. Div., P. O. Box 12, New York 36, N. Y.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED —RATES— DISPLAYED
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DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).
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EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS or Inquiries to Classified Advertising Div. of Chemical Engineering, P. O. Box 12, N. Y. 36, N. Y. for December issue closing November 1st.

NEW AND GOOD-AS-NEW EQUIPMENT

1—Stainless Tank #430 Chrome vert. 7'x10' deep.
20—Jacketed Kettles—Stainless Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Copper Evaporator, steam jacketed 9'1"x3'9".
68—New Pressure Cookers, 18"x18" & 24"x23".
1—New Glass Nash Centrifugal Pump, 100 gpm.
1—New Nash Vacuum Pump Type AL-672.
1—Bullovak Jacketed Impregnating Tank 42"x52".
1—Stedman Disintegrator size 40-S.
1—Abbe Ball Mill, 36"x42" Buhrstone lined.
#316 Stainless Steel Tanks, new 100, 200 & 360 gal.
1—Nash Air Compressor, Type AL-522.
1—Manton Gaulin Stainless Homogenizer 125 gph.
1—I&R Vacuum Pump, 5 H.P., 60'.
4—Heat Exchangers, 12" dia. 11' lg., 43 steel tubes.
1—Stokes Single Punch Tablet Machine.
1—Raymond 6" Hammer Mill, like new.
Davenport Rotary Steam Tube Dryer, 6'x36'.
1—New Louisville Continuous Filtering Machine.
2—Stainless Steel Steam Jacketed Readco Mixers.
1—#316 Stainless Reactor, 265 gals. cap., jacketed.
Abbe, Pebble & Tube Mill, 5'x22'—Buhrstone Lined.
1—Patterson Ball Mill, porcelain lined 17"x27".
1—Patterson Ball Mill, 42x36, jacketed.
2—Large Steam Jacketed Horizontal Mixers.
2—Ribbon Type Mixers, 50 & 90 cu. ft.—like new.
4—Steel Tanks 90,000 gals. ea. vert. welded const.
3—Crystallizers—10' long.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
1—#10 Day 300 gal. jacketed Sigma Blade Mixer.
4—New Heat Exc. 60' with Copro Nickel Tubes.
1—Sparkler Stainless Filter Model 33-S-9.
3—2500 gal., Pfaudler G/L Tanks & S/S Agitators.
1—150 gal. Steam Jacketed closed Tank 200#. A.S.M.E.
3—Carver Laboratory Presses.

H. LOEB & SON -:- 4643 LANCASTER AVE., PHILADELPHIA 31, PA.

JAW CRUSHERS 6 x 12 Cedar Rapids, 20 x 4 Farrel, 14 x 28 Aeme, 15 x 24 Taylor.
ROLL CRUSHERS 16 x 10 Allis Chalmers, 30 x 16 Chambers,—Gyratory #5 Allis Chalmers.
SCREENS Tyler 3 x 5 & 5 x 10 double, 3 x 10 double Cedar Rapids, 5 x 14 double Robins.
MILLS—HARDINGE CONICAL 6' x 22" ball, 7' x 22", 7' x 48" pebble.
MILLS—ROD 13 x 24" Marcy lab type.
MILLS—TUBE 4 x 16 porcelain lined, 5' x 20' ball.
ROTARY DRYERS—15" x 22', 30" x 25', 39" x 21', 44" x 25', 6' x 40'.
PEBBLE MILLS—18 x 24, 24 x 36, 24 x 36, 4 x 5, 5 x 6 porcelain, 6 x 8 & 6 x 9 Buhrstone, 24 x 18 rubber, all with motors.
MIXERS 5 Cu. ft. Muller type, EBG3, EAG3, Blystone 6R1 w/hoist & motor drive.
FILTER PRESSES—7" lead w/lead pump, 12" C. I. 4 eye.
STAINLESS STEEL AUTOCLAVE—1 gal., 1000 PSI, Kettle 65 gal., Condenser 50 sq. ft.
FURNACE—U. S. Smelting #1 oil fired, Electric 36 cu. ft. 2600 F.
DUST COLLECTOR—Aerodyne (practically new). Dracco AA 1000 sq. ft.
BLOWER/EXHAUSTERS unused—Sturtevant size 115, Design 7, 24000 CFM, American 600(22000 cfm)—Buffalo M(45)12000 CFM.
GRANULATOR—unused Colton oscillating #2 special w/motor.

LAWLER COMPANY
Durham Avenue Metuchen, N. J.
Liberty 9-0345

FOR SALE
Used—Reconditioned—Dependable Machinery

Ball Mills:
1—66 Marcy, w/250 Motor
1—6 x 6 Allis Chalmers w/150 motor
1—5 x 5 Allis Chalmers w/75 HP motor
3—8' x 48" Hardinge Conical w/200 HP motor
1—8 x 36" Hardinge Conical w/150 HP motor
Dust Collectors:
2—Rotocione, Size 12
1—Rotocione, Size 14 with 2 American Filter Co Exhauster
Bagging Machine:
1—St. Regis, 2 spout, Type 107-PC Like new, bargain
Filters:
1—4½' x 6' Oliver Drum, complete
1—6' x 4' Denver Drum, complete
3—6' — 6 leaf Oliver-American, complete
1—4' — 4 leaf Elmco, complete
1—6' — 2 leaf American, complete
Dryers:
1—48" x 20', oil fired
1—54" x 30', DECO, Gas fired, excellent
1—60" x 35', Ruggles-Cole, gas fired
Pumps, Acid:
2—1" Willey, Model AC, 3 HP
PH Meter:
2—Beckman Model R, one with Bristol Recorder
Cyclone:
1—Dorr, 2", 20 deg.
1—Kreba Centricione, Size A-10, 7½ HP

MACHINERY CENTER, INC.
Box 964-Salt Lake City, Utah-Phone HUnter 4-7601

AN IMPORTANT NOTE

"We specialize in *quality* rebuilding of roller mills, pony mixers, colloid mills and other process machinery. Consult us if your equipment requires reconditioning. We also purchase surplus equipment and complete plants."

IRVING BARCAN COMPANY
249-51 Orient Avenue
Jersey City 5, N. J.
DElaware 2-6695-6

Blaw-Knox 50 gal. S/S Reactor
Sparkler 33-26 Rubber lined filter
Patterson 4' x 5' Burhstone Mill
Abbe 3' x 3' x 6" Burhstone Mill
D & P Size 6 Cl Mixer-New
W & P size 15 Mixers
400# S/S Double Ribbon Mixers
1000# S/S Double Ribbon Mixers
Colton type 10-25 tablet press
Colton No. 216 Tablet Press
2000 gal. S/S Tank—¼" thick
Proc. Scient. 8gph Water Still
Proc. Scient. 25gph Water Still

Additional Equipment in stock. Send us your inquiries and offerings.

Aaron Equipment Company
1843 So. Blue Island Ave.
CHICAGO, ILL.

BOILERS

HI-PRESSURE

Complete stock from 10-2,000 h.p.
Nation's largest inventory, New & Used

WABASH POWER EQUIPMENT
31 E. CONGRESS, CHICAGO 5, HA 7-4855

FOR SALE
NEW EQUIPMENT — NEVER USED

310 Ton York Water Chilling Set-up complete with 300 HP motor, Turbo Compressor, Speed Increaser, Chiller, Condenser, Controls, etc.

JOHN F. CARSON
A & Venango Sts. Phila. 34, Pa.
GArfield 6-2221

You hit the DOUBLE jackpot . . .

1 SATISFACTION 2 ECONOMY with BRILL

RE-NU-BILT EQUIPMENT

See Additional Listings on Page 456

DRYERS

2—Vulcan 6'x40', 4½'x50' Rotary.
3—Link Belt 5'2"x20' 7'5"x25', 11'6"x36' Roto-Louvre.
4—Devine double door Vacuum Shelf 17 and 20—59"x78" shelves.
2—Devine 5'x33', 4'x25' Rotary Vacuums.
1—Devine 5'x10' Rotating Vacuum.
2—Hersey 4'x30', 1½'x12' Rotary, 304 S.S.
1—Buflovak 6'x5'6" Monel, Drum Flaker, NEW.

FILTERS

2—Oliver Rotary, Monel 8'x10', 3'x2'.
1—Feinc 5'x3' Rotary Vac. Monel.
2—Feinc 3'x1', Rotary Vac, 316 S/S.
1—Eimco 18"x12", 316 S/S.
2—Sweetland No. 12-48 & 32 leaves.
1—Sweetland No. 7, 20 S/S covered leaves.
2—Sweetland #3, 75 sq. ft. 304 S/S.
1—Niagara 230-32 230 sq. ft. 304 S/S.
3—Shriver 30" P&F, 36 chambers, iron.
4—Shriver 24" P&F, 30 chambers, iron.

PULVERIZERS—CRUSHERS

1—Dixie No. 3620 non-clog Hammermill.
4—Hardinge Mills 4½'x16", 5'x22", 5'x36", 6'x22", 8'x48".
4—Patterson 6'x8', 5'x6', 3'x4' brick-lined Pebble Mills.
1—Patterson 6'x8' porcelain (Berylite) Pebble Mill, 50 HP, NEW.
2—National 6"x12" Mills.
3—Gayco Air Separators 12', 8', 18".
3—Mikro Pulverizers #2 Bantam, 1SH, 2TH.

CENTRIFUGALS

2—Bird 40" suspended, 347 S/S.
1—AT&M 40" suspended, steel.
1—Bird 40" suspended, rubber.
3—Tolhurst 40", 32", 26", suspended.
1—AT&M 36" centerslung, rubber.
1—Fletcher 30", centerslung, 304 S/S.
1—Bird 36"x50" steel, solid bowl, continuous.
2—Bird 24"x38", 18"x28", 316 S/S, solid bowl continuous.
4—Sharples No. C-27, C-20, 316 S/S Superdehydrators.
1—Sharples PY14, Super-D-Canter, 304 S/S.

LIQUIDATION

TOLEDO, OHIO

3—Pfaudler, Model RM, 1000 gal. jacketed, agitated Reactors.
1—Struthers-Wells 375 sq. ft. Single Effect Evaporator, 316 S. S.
1—Tolhurst 48" rubber covered, suspended type Centrifugal.
1—Tolhurst 40" rubber covered, suspended type Centrifugal.
2—Bird 18"x28" solid bowl, Continuous Centrifuges, 316 S. S.
2—Sperry 30"x30" Heresite coated P&F Filter Presses.
7—Durimet 2" Centrifugal Pumps, 5 H.P. motors.
2—Chlorimet 3"x2" Centrifugal Pumps, 10 H.P. motors.
3—Olivite 2" Centrifugal Pumps, 5 H.P. motors.
1—Olivite 5"x4" Centrifugal Pump, 10 H. P. motor.
6—Duriron 2" Centrifugal Pumps, 5 H.P. motors.

Attractively priced for immediate removal—
Your inspection invited.

Wire! Phone! Write!

SCREENS

3—Robinson single deck 40"x84", 304 S/S.
2—Sprout Waldron single deck 40"x84", 304 S/S.
1—Patterson single deck 40"x84", 304 S/S.

MIXERS

1—Baker Perkins 100 gal. 304 S/S sigma blades, jacketed, 25 HP motor.
1—Baker Perkins #JNM-2, 50 gal., 316 S/S, sigma blades.
8—Day "Cincinnatus" double arm sigma blade, 550, 200 & 100 gal.
1—Robinson 90 cu. ft. 316 S/S jacketed, powder.
1—4' dia. 304 S/S Conical Blender, 7½ H.P. motor.
9—Steel jacketed Powder, 50, 225, 265, 350 cu. ft.
1—Robinson 4000# steel Powder.

MISCELLANEOUS

2—Lawrence 5" Hastelloy "C" centrifugal Pumps.
8—Nash Vacuum Pumps #H-7, #H-6, #4, #2, #L-5, #L-3, #L-4.
3—Stokes 412 and 212 Vacuum Pumps.
20—Durimet, Olivite 316 S/S Duriron Centrifugal Pumps 1" to 3".
10—Centrifugal Pumps 60 to 2000 gpm, motor driven.
7—Stokes DDA, BB2, DS3, B2, "R", "O" and "F" Tablet Presses.
1—Stokes 21-J, 304 S/S Granulating Mixer.

IF YOU DON'T SEE IT LISTED—ASK FOR IT—WE HAVE IT

TEXAS OFFICE—4101 San Jacinto St., Houston 4, Texas—Tel: Locust 1351

BRILL EQUIPMENT COMPANY
2401 THIRD AVENUE, NEW YORK 51, N. Y.
Telephone: CYpress 2-5703 • Cable: Bristen, N. Y.

A SINGLE ITEM OR A COMPLETE PLANT!

Write, wire or phone us for complete information. Send us your surplus equipment lists today

OUT STANDING

7—Kux Lehner Model 61 Tablet Presses

1—Buflovak 42" x 120" Double Drum Dryer

1—Buflovak 6" x 8" 2 Drum Dryer—chrome plated

4—Klein & Puro-cel S/S Filters—100 & 75 sq. ft.

2—92 & 25 cu. ft. Stainless Conical Blenders

3—Simpson #0 Intensive Mixers

2—Sweetland #11 Stainless Filters, hydraulic closing

1—Stoker 25-gal stainless Vacuum Pan

1—Fitzpatrick model K Stainless Comminuting Machine

1—1000 gal Stainless jacket & agitator Reactor

1—Day 14 x 30" high speed 3 roller mill

1—Lehmann 9 x 24" high speed 3 roller mill

1—Lehman 5 x 12" high speed 3 roller mill

2—Stainless steel 316 heat exchangers—200 sq ft

3—Stainless steel 7000 and 1200 gallon open top tanks type 316

1—Stainless steel 600 gallon horizontal closed tank

2—Colton stainless steel model 17-TF tube fillers, closers and crimpers

1—Rotex 40 x 84" stainless steel single deck sifter

2—Baker-Perkins 20 and 2½ gallon jacketed double arm mixers

10—Day Imperial 75 and 50 gallon jacketed double arm mixers

We Buy & Sell – Send Your List

CHEMICAL & PROCESS MACHINERY CORP.

52 9th Street HYacinth 9-7200 Brooklyn 15, N. Y.

LOEB OFFERINGS

Agitators, portables: ¼ to 5 hp.
Centrifugals: Fletcher 12" copper.
Fletcher 20" lithocoated.
Tolhurst 26" copper.
Tolhurst 24" rubber covered.
Centrifuge: International size 3, model FB, 2 hp.
Clarifiers: De Laval 84-51, SVK3R, 04-21.
De Laval #600 multiple.
Condensers: stainless steel and copper.
Conveyor: screw: Hammond 16' st. steel, 3 hp.
Cutter, rotary: Abbe stain. steel.
Demineralizer: Barnstead 80 GPH.
Dryers: Devine 2 x 4' vac. drum st. steel.
Bowen laboratory Spray type.
Devine #1 vacuum 8 shelf.
Devine vacuum 20 shelf.
Ruggles Coles XA 4 x 20' rotary.
Double drum atmospheric to 120".
Rotary Vacuum 2½ x 8'.
Louisville Davenport Steam Tube.
Evaporators: Swenson triple effect 350 sq. ft., single effect 250 sq. ft.
Mojonnier st. steel, 392 sq. ft.
Rogers Special 5' stain. steel.
Exchanger, heat: Walker Wallace st. steel, plate type, 200 GPH.
Filters: Oliver 3½ x 1', Sparkler, Alsop, Lomax, Industrial, Oliver 3' horizontal.
Filter Presses: Sperry, Shriver 6" to 36".
Kettles: Stainless steel 20 to 150 gal., with and without agitators.
Devine 1500 gal. jacketed agitated.
Dopp 150 gal. dbl. act. st. agitator.
Mills: Pebble, Abbe #5, 36 gal.
Ball: Hardinge 6' x 36" buhr. lined.
Mikro: 2 DH, 10 hp. New.
Hammer: Jeffrey 30 x 24" type A.
Hammer: Williams size BX type AX.
Raymond: 0000 IMP, 16" screen mill.
3-roll: Ross 12 x 30". Day 12 x 32".
Mixers: Dbl. and sgl. arm sigma blade. Jacketed horiz. 350 gal., st. steel.
Day Imperial #10 st. steel.
Dry Powder: 1½ to 77 cu. ft.
Dry Powder: Day copper body, 27 cu. ft.
Liquid tank to 500 gal.
Pony: Day 40 gal., Ross 20 gal.
Pumps: Centrifugal, rotary, gear, vacuum. In various sizes and metals.
Reactor: VanAlst st. steel 18 x 60".
Screens: Rotex 20 x 48" and 40 x 84".
Selectro 4 x 10', Abbe Blutergress #1.
Separator: DeLaval AC-VO Nozzle-Matic st. steel.
Sterilizers: Climax 20 x 36" jacketed.
Tablet Machines: Single punch and rotary.
Tanks: Stain. steel to 6000 gal. cap.
Stain. steel rectangular 4 x 4 x 11'.
Glass lined to 500 gal. cap.

Send us your inquiries and list of idle equipment.

LOEB EQUIPMENT SUPPLY CO.

818 West Superior St. Chicago 22, Ill.
Telephone: Seeley 8-1431 Our 32nd Year

Buy With Confidence

2—#12 Sweetland Filters, on 2" and 4" c.c., with monel covered leaves. 1—#2.25 copper leaves 1½" o.c. Bronze leaves for #12. 24-steel rim, 12 monel rim Unused, 48 slightly Used.

1—Stainless Steel Chilling Roll, 5'x8', M.D.

4—5'x8', 4'x5' Per. Lined Pebble Mills.

2—Day 15 gal. Pony Mixers, S.S. cans, M.D.

1—Stainless Steel Hersey Rotary Dryer, 5'x20'.

2—6'x125' Rotary Kilns.

3—Buflovak 42x120, 32x120 Atmos. D.D. Dryers.

1—Williams 5-roll "Super-Titan" Mill with spinner separator, exhauster, motors, etc. Complete.

1—#5057 Raymond High Side Roller Mill.

1—Day #30 Imperial Jack. Mixer, 75 gals.

5—Sperry 18"x18" Filter Presses, 11 chambers.

Our 39th Year

CONSOLIDATED PRODUCTS CO., INC.

60 Bloomfield St., Hoboken, N. J.
Tel: HO 3-4435 • N. Y. Tel.: BA 7-0600

6' x 35' LOUISVILLE ROTARY DRYER

1—6 ft. dia. 35 ft. long horizontal Steam Tube Rotary Dryer with 34 - 4 inch tubes, 15 H.P. G.E. Motor and Phila. Speed Reducer.
1—4x30 & 1—4x40 Single Shell Dryers.

DARIEN CORP.
60 E. 42nd St. N. Y. 17, N. Y.

If there is anything you want that other readers can supply
OR . . . something you don't want— that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

FOR SALE

Riley Steam Generating Boiler

1700 H. P.—60,000 lb. per hr Water tube boiler.
5300 Sq. ft. heating surface.
1600 Sq. ft. water wall surface.
353# pressure—arranged for coal, oil or gas
Completely equipped with blowers, fans, turbines, controls, dust collector.
Replacement cost approximately $400,000.00.
Open for offer—for immediate delivery.
For further information—contact
M. J. ANDERSON
Crosby Bldg. Mohawk 2650—Buffalo, N. Y.

SEE OUR STOCK

FOR SALE

Waste Disposal Plant including Oliver Precoat Filter 5' 3" dia. x 8' face with Nash Hytor Vacuum Pump and motor; 18' dia. leadlined steel reacting tank, piping, pumps, agitators, etc. Built 1951 —UNUSED

CENTRIFUGALS

1—AT&M Susp. 48" dia. Perf. Basket, St. St., Fume tight
2—Fletcher Susp. 40" dia. Imperf. Basket, 1 plain steel, 1 rubber covered
3—Bird 24" x 24" Horiz. Centrifugal Screen Filters, Monel
1—Bird 36" x 50" Solid Bowl, Steel
4—DeLaval Nos. 74-11; 94-01; 600
3—Sharples Centrifuges & Super D-Hydrators

DRYERS

4—Devine #27 Vacuum Shelf, 475 sq. ft.
2—Devine Vacuum Shelf Dryers, size 17, 80 sq. ft. UNUSED.
1—Buflovak "C" Vac. Shelf, 55 sq. ft.
1—St. St. Spray Dryer, 19' dia. x 20' high, with Western Precip. nozzles, fans, oil burners, etc.
1—Bowen 5' dia. Stainless Steel Spray Dryer
1—Bowen St. St. Laboratory Spray Dryer
8—Double Drum Dryers; 42" x 120"; 36 x 84"; 32" x 52"; 24" x 60"; 24" x 36"; 22" x 38"
4—Rotary Hot Air Dryers: 4'6" x 40'; 4'6" x 32'; 3'6" x 25"; 3' x 24'
2—Rotary Coolers: 104" x 30' and 104" x 70'
1—B & S Rotary Hot Air Dryer, 3' x 15', Everdur (Silicon Bronze)
1—Stokes 3' dia. x 15' long Jacketed Rotary Vacuum Dryer
2—Rotary Steam Tube Dryers: Louisville 6' x 30' and Ruggles Cole 4' x 30'
2—Davenport size 2A Dewatering Presses
2—Swensen Walker Crystallizers, steel, jacketed, each 30' long

EVAPORATORS—STILLS

2—Bartlett Snow St. St. Jacketed Evaporating Kettles 6' dia. x 3' deep with heavy duty agitator and 25 HP 4-speed drive
1—Conkey 1900 sq. ft. Triple Effect, Evaporator Vertical long Herculoy tubes
1—Buflovak size 6.5 model 629D Double Effect, all stainless steel, 588 sq. ft.
1—Struthers-Wells Single Eff. St. St. 625 sq. ft.
1—Stainless Steel 145 sq. ft. coil, 500 gal.
1—Stokes 150 gal. St. St. Jacketed Vacuum Still
1—Stokes type 316 St. St. Double effect water still, 250 GPH

AUTOCLAVES—REACTORS

6—465 gal. St. St. 3' dia. x 8'6" deep, 150# WP, 165# jkt. pr.
1—1420 gal. St. St., 4' dia. x 15' deep, 200# WP, 85# jkt. pr.
1—400 gal. St. St., jktd. & Agit., 100# WP, 140# jkt. pr.
1—500 gal. Pfaudler Glass Lined, Jktd. & Agit.
2—30 gal. Pfaudler Glass Lined, jktd. & agit.
2—Blaw Knox ½ gal. St. St. agit. 2000# Pr.
3—St. St. T347, 13 gal. 1400# test, 50# jkt.

FILTERS

1—Niagara Model 510-28 type 316 Stainless Steel Filter, 510 sq. ft.
1—Feinc 6'6" D x 6' Face String Discharge
2—Eimco 10' x 12' Rubber Covered Filter
3—Sweetland Filters: #12 (12 lvs.); #(20 lvs.); #2 (18 lvs.)
5—Cast Iron Filter Presses, 30" x 30" open delivery. 28, 35, and 50 chambers
5—Filter Presses, closed delivery, 7" x 36"

MILLS

1—Patterson Fdy. 5' dia. x 22' long Ball Tube Mill, 200 HP motor. Built 1952—UNUSED
1—Hardinge 6' D x 22" L Conical Ball Mill
1—Al. Ch. 6' D x 16' L Steel Lined Contin. Ball Mill Granulator
1—Charlotte #50 Colloid Mill, 75 HP
1—Pug Mill, St. St., two 7" dia. overlapping chambers 3'9" L. Jktd.

Mikro Pulverizers — Hammer Mills
Attrition Mills — Jaw Crushers
Comminuting Machines—Pebble Mills
Send us your inquiries—write for detailed list

MIXERS—BLENDERS

1—Gemco St. St. 30 cu. ft., 54" dia., Jktd. Conical Blender
1—Patterson 60" dia. Conical Blender
1—Day 75 gal. work. cap. Stainless Steel Sigma Blade double arm jacketed mixer
2—Readco Heavy Duty Double Arm Sigma Blade Jacketed Mixers 50 gal. work. cap. 30 HP Expl. Pr. Motor. Built 1951-53
3—Sprout Waldron size 12 Ribbon Mixers, 336 cu. ft. work. cap.
1—W & P Sigma Blade Double Arm Jacketed Mixers, 50 gal. & 100 gal. work. cap.
9—Side Entering Stainless Steel Mixers, 7½ HP, 10 HP, 15 HP & 25 HP
3—Falk Vertical Agitator Drives #10-GDX, 10:1 300 HP—UNUSED
8—Turbo Vertical Drives, #5B, 5:1, 40 HP
2—Lancaster type SKG Counter Current Mixers, 29½" dia. pan
1—Sprout Waldron type 3036 Swing Head BB Blender, 50 HP

MARCO FLOW-MASTER UNITS
Stainless Steel
New in 1952—Expl. Pr. Motors

1—KACR Reactor, ser. #3127
1—Kon-Bi-Nator, 200 GPH #3114
1—AC-500 Homogenizer, #3125
2—Roto-Feed Mixers, #3129, 3130
1—DP-Dry Proportioner, #3131

TANKS

12—Aluminum, 3000 gal., 5 compart.
10—Aluminum, 500 gal., 80# WP.
1—St. Clad, T304, 3/16", 6500 gal. Vert.
10—St. St. Pressure Tanks—to 4000 gal.
20—St. St. Storage Tanks—to 1000 gal.

STAINLESS STEEL EQUIPMENT

USED EQUIPMENT IN STOCK—Tanks, Kettles, Receivers, Exchangers and Condensers, Stills, Agitators, etc.

NEW TANKS IN STOCK—From 30 gal. to 10,500 gal. sizes. Also large stock of prefabricated tank sections and heads to assure quick delivery of tanks.

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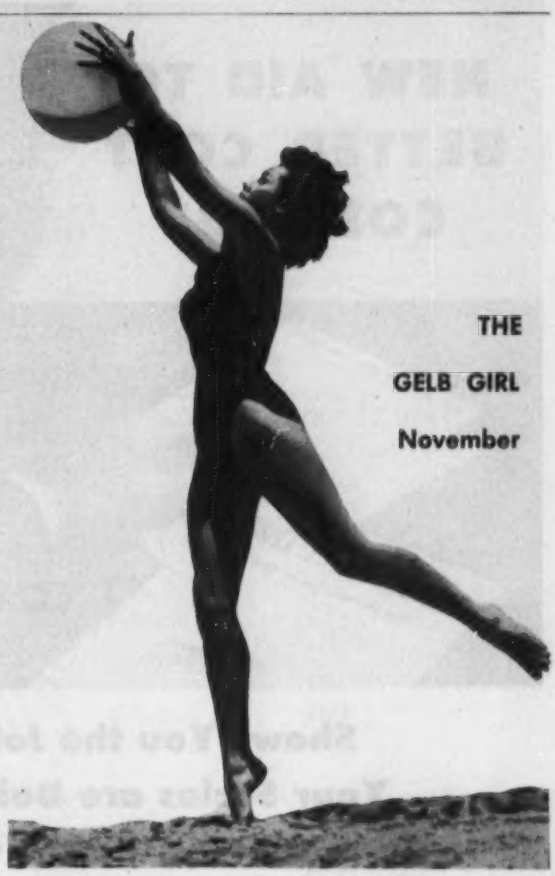

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1—Stokes Double Drum Dryer, 5'x12', ASME, complete.
1—Buflovak Double Drum Dryer, 42"x120", ASME.
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10—Baker Perkins double arm sigma blade jacketed Mixers, 100 gal.
1—Readco Double arm sigma blade jacketed Mixer, 50 gallons.
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which **takes the place** of pipe coils, didn't exist. Look, for instance, at the unusual tank below—made entirely of Dean Thermo-Panel Coil prepared for an inner protective coating or lining—ideal for many uses in the chemical industry. In grandpa's day such a structure was hardly possible.

Look, too, at the curved panels shown in previous issues of CHEMICAL ENGINEERING—also impossible in grandpa's day. Costs are now reduced. Less space is required. Heating or cooling is quicker. Efficiency is higher.

52-page Bulletin 255 makes everything perfectly clear. And with its help you can do your own designing. Feel free to ask for it. Dean engineers, if you wish, will help too.

Backed by 20 years of Panel Coil Manufacturing.

DEAN THERMO-PANEL COIL DIVISION
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3. Broad administrative and technical experience with the design and construction of petroleum and chemical plants.
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CHEMICAL ENGINEERING

Reader Service

A. J. BABKOW, MANAGER C. J. ROHRBACH, EDITOR

November 1956

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Get more information—fast ..... **Inside Cover**

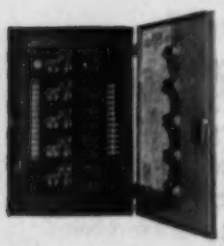
FIRE! HOW TO DETECT AND EXTINGUISH IT IN SECONDS!

HAND PORTABLES

Carbon Dioxide | Foam Soda-Acid Clear Water Anti-Freeze | Pressurized Water Anti-Freeze | Dry Chemical

Kidde CO_2 portables, either trigger-release type or squeeze-valve type models, are available in sizes from 2½ to 20-pound capacities. New Kidde Wet Chemical Extinguishers are available in 2½ gallon bronze or stainless steel models, including pressurized Water or Water-Anti-Freeze units (illustrated). Kidde Dry Chemical extinguishers are available in cartridge-operated models of 20 and 30 pounds capacity or pressurized models of 5 and 10 pounds capacity.

ATMO DETECTING SYSTEMS

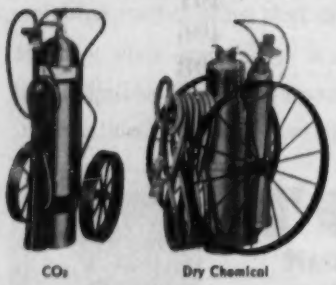


Kidde-Atmo is a wide-area automatic fire detecting and warning system which works on the principle of rate-of-temperature-rise. It is ideally suited for cases where life protection is of vital importance, or where quick, early detection of fire in valuable materials is essential.

The very first hot breath of fire triggers the system, and sounds the alarm. In addition, the system can also close doors, shut off fans or blowers – all *automatically*.

What's more, the Kidde-Atmo system operates independently of regular power sources, will still give protection even if outside power fails.

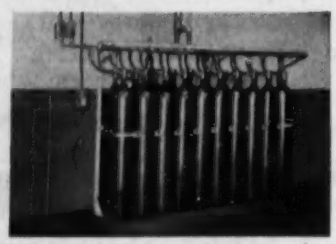
MOBILE EQUIPMENT



CO_2 | Dry Chemical

For major fire hazards, get a mobile unit. Wheeled CO_2 units are available in 50, 75 and 100-pound capacities, in one clyinder. 150-pound Dry-Chemical unit has straight stream for long range ...fan pattern for wide coverage. Both units give expert results even with inexperienced operator.

CO_2 SYSTEMS



New Kidde pressure-operated CO_2 extinguishing systems are individually designed to fully protect even the most dangerous hazards. Directional Valves afford protection to more than one hazard using the same bank of CO_2 cylinders.

Kidde

Walter Kidde & Company, Inc.
1128 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada Ltd., Montreal — Toronto

THIS MONTH'S

Products

• **Your complete index to chemicals, materials, equipment and services taken from this issue's advertisements, new products departments and "Guide to Technical Literature."**

• **Products listed feature code numbers which show the page on which they appear. L (left), R (right), T (top), B (bottom) indicate ad location; A, B, C, etc. and a, b, c, etc. identify specific product items on an editorial page or in an ad.**

• **You can get information on any listings by circling its key number on the Reader Service Postcard (see inside back cover). Replies will come direct from the companies manufacturing the products.**

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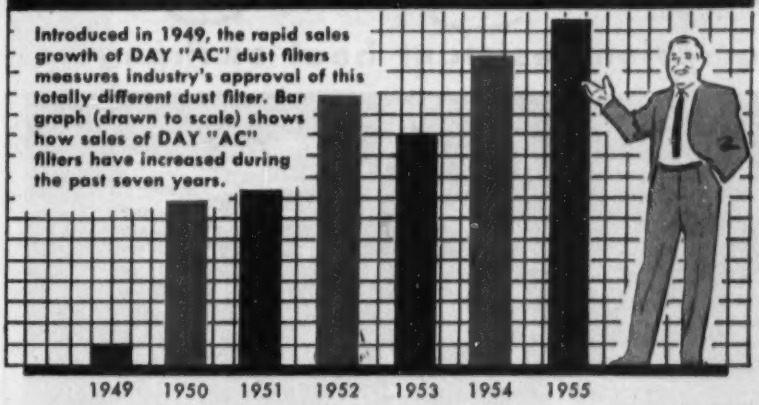
DAY REVERSE JET DUST FILTERS

HAVE EARNED INDUSTRY'S ACCEPTANCE


Introduced in 1949, the rapid sales growth of DAY "AC" dust filters measures industry's approval of this totally different dust filter. Bar graph (drawn to scale) shows how sales of DAY "AC" filters have increased during the past seven years.
1949
1950
1951
1952
1953
1954
1955

HERE'S WHY — **DAY Reverse Jet Dust Filters HAVE EARNED ACCEPTANCE!**

Utilizing the Hersey principle of reverse air cleaning, DAY "AC" dust filters brought industry a needed, long overdue, improved dust filter. This filter has many benefits never before found in any dust filter equipment.

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● NEW FILTER MEDIA—DAY *felted* filter media traps more dust than woven fabric. Felt gives higher efficiency, longer life and has same pressure drop as woven fabric.

● NEW DESIGN FEATURES—The Hersey principle of reverse jet cleaning, DAY self-adjusting blow rings, sanitary square-to-round air inlets, automatic-continuous operation, superior filter media, are just a few of the features introduced by DAY.

● NEW FILTER TUBE CLEANING—Patented self-adjusting blow rings clean the entire filter tube automatically and continuously, to give DAY filters an air handling capacity 5 times higher than ordinary filters.

● NEW LOW INSTALLATION COSTS—Unit sub-assembly saves time and money—up to 75% on filter erection costs.

Licensed by H. J. Hersey, Jr.

The DAY "AC" Reverse Jet Dust Filter is the largest selling filter of its type in the world!

Place the successful operation of your dust control system in our hands. Experienced DAY Application Engineers will survey your plant and supply you with engineered recommendations. With DAY there is no divided responsibility. Our guarantee of satisfaction is backed by 75 years of experience.

Bulletin 559 gives important facts and complete description of the DAY "AC" dust filter. Write toDAY for your copy of this informative 24-page bulletin.

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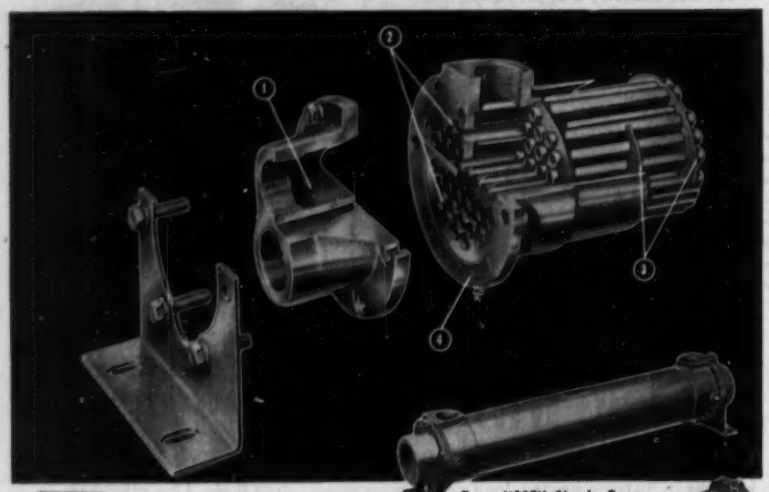
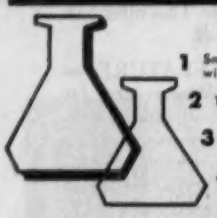
corrosion-resistant heat exchangers



Type "SSF" Single Pass



1 Smooth flow bonnet distributes fluid with minimum turbulence to tubes.

2 Tubes are rolled into headers.

3 Baffles made to close tolerance.

4 Gasket eliminates by-passing, fluid leakage.

Type "SSF" Multipass

Chemical Pilot Plants Use Young

The challenging and exacting requirements of the Chemical industry as exemplified in its pilot plant operations are met and fulfilled by Young engineering talent. To heat, cool, condense or evaporate liquids and gases, chemical pilot plants need heat exchangers which are *compact, economical, dependable* and *resistant to acids and corrosion*. Young Stainless Steel "SSF" Heat Exchangers are the answer to this requirement. These exchangers assure greater initial and operating economies with more cooling surface per unit volume. Young features include factors for fouling and safety, and provide an extra reserve capacity when conditions warrant. Tubes are readily accessible for cleaning. Available in wide range of sizes.

Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

Write to Dept. L 316 for Catalog No. 1155

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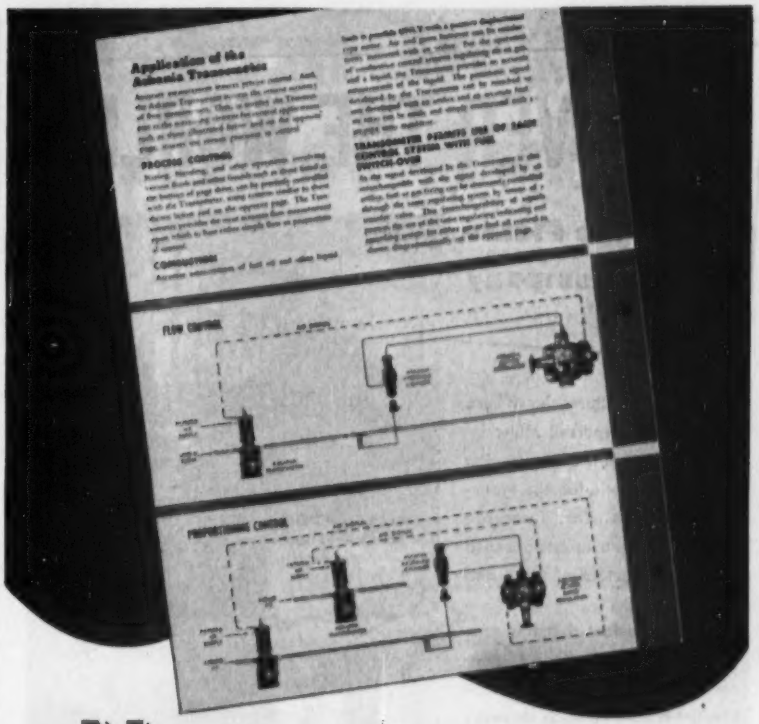

NEW BULLETIN SHOWS HOW TO METER, INTEGRATE AND CONTROL WITH THE *ASKANIA* TRANSOMETER

Describes Flow, Indication, Recording and Control Applications For Fuel Oil, Viscous and Other Liquids

A new illustrated booklet is now available to men interested in technical information on the Askania Transometer which:

1. is an unusually accurate flow meter
2. integrates the flow of viscous liquids and other liquids (including fuel oil)
3. develops a pneumatic signal for recording and control purposes.

Bulletin #301 includes a listing showing typical liquids that can be measured by the Askania Transometer. It illustrates:
how the liquids are metered and integrated
how the signals for the recording and control are developed.

● APPLICATION DRAWINGS

Of particular interest are the operational diagrams and descriptive information showing:
flow, proportioning and combustion controls
totalization of multiple fuels
interchangeable control for fuel switch over hook-ups.

These show at a glance just how:
the liquid is metered, the air signal is dispatched to the Jet-Pipe Regulator
the regulator actuates the hydraulic cylinder for the control valve.

Ranges and specifications by connecting pipe sizes, flow range, operating pressure and maximum operating temperature limit are provided.

● DESIGN FEATURES

An additional feature of the new bulletin is the added information and specifications on Askania's simple, economical constant flow valve which can be used to economically maintain a constant flow.

For your copy of the Askania Transometer Bulletin—fill in the enclosed coupon and mail, or write to Askania Regulator Company, 288 E. Ontario, Chicago, Illinois

Yes, send me a copy of bulletin #301
NAME _____
TITLE _____
COMPANY _____
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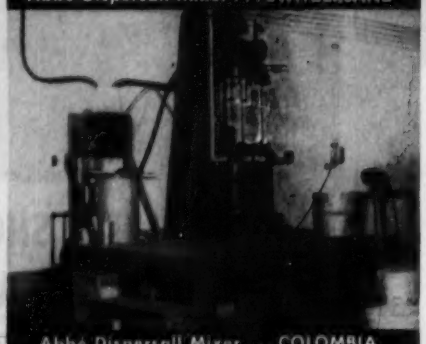
ALL OVER THE WORLD

in the Plants of One Company

The pictures shown here are of Abbé Dispersall Mixer installations in a few of the foreign plants of a world-famous manufacturer of cosmetics. There are many more. These mixers are used in the manufacture of tooth and other pastes.

The fact that this company has adopted Abbé Dispersall Mixers for pastes in its foreign plants (as well as in its domestic factories) is ample evidence of the superior performance of these mixers.

Abbé Dispersall Mixer . . . SWITZERLAND



Abbé Dispersall Mixer . . . COLOMBIA

Abbé Dispersall Mixer . . . VENEZUELA

Abbé Dispersall Mixer . . . DENMARK

Here's What They Say About These ABBÉ DISPERSALL MIXERS:

"They have met our requirements for a versatile piece of equipment suitable for relatively small scale production. They have the valuable quality of being easy to clean, which, as you can appreciate, is a decided advantage when more than one product is made in the same machine."

If You Are Mixing Liquids or Pastes...

ask us for a recommendation, as well as full details on the advantages of the Abbé Dispersall Mixer.

ABBÉ ENGINEERING COMPANY
50 Church Street • New York 7, N. Y.

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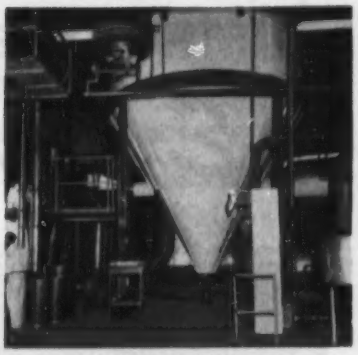
Custom Drying ...Test Runs

NERCO NIRO® Spray Dryers



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PILOT SIZE UNIT

To meet your requirements for large tonnage custom spray drying, small and large scale test runs and batch testing, Nerco-Niro offers, at Netcong, New Jersey, the most completely equipped facility of its kind. Drying equipment includes:

1. **32" diameter laboratory unit.**
2. **7'-6" diameter pilot size unit.**
3. **16'-0" diameter commercial size unit.**

Our plant incorporates:

- **Expert engineering supervision**
- **Process steam throughout the plant**
- **Jacketed feed pipes**
- **All stainless-steel equipment**
- **A large warehouse**
- **Railroad and truck sidings**
- **Modern materials handling equipment**

We invite you to take advantage of the great savings in expense, time and labor that are possible through using this Nerco-Niro service.

Write for Bulletin No. 232 for a more detailed description.

Nichols Engineering & Research Corp.
Nerco-Niro Spray Dryer Div.
70 PINE ST., NEW YORK 5, N. Y.
Laboratories: Netcong, New Jersey

For more information return the coupon below.

Nichols Engineering & Research Corp. - Nerco-Niro Div.
70 Pine Street, New York 5, N. Y.

Please send me more information on your spray drying laboratory services.

NAME_____ **TITLE**_____

CO. NAME_____

STREET_____

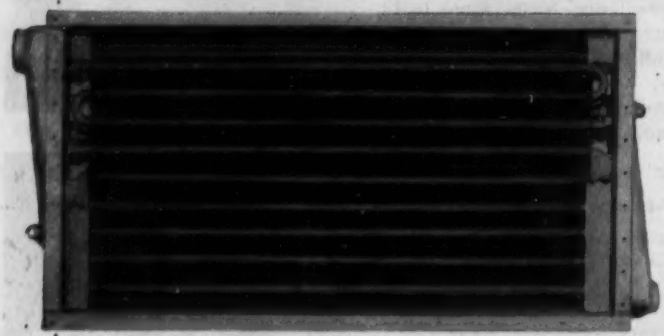
CITY_____ **ZONE**____ **STATE**_____

We Make

Extended-Surface

HEAT EXCHANGERS

Exclusively!



The pioneer in the field, Aerofin has concentrated on one thing, *and one thing only* — highly efficient, easily installed, easily maintained extended-surface heat exchangers. Aerofin's design, research, engineering and production experience and facilities are unequalled anywhere.

For High Efficiency, Easy Installation, Low Maintenance and Servicing Costs . . .

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Aerofin is sold only by manufacturers of fan system apparatus. List on request.

AEROFIN CORPORATION

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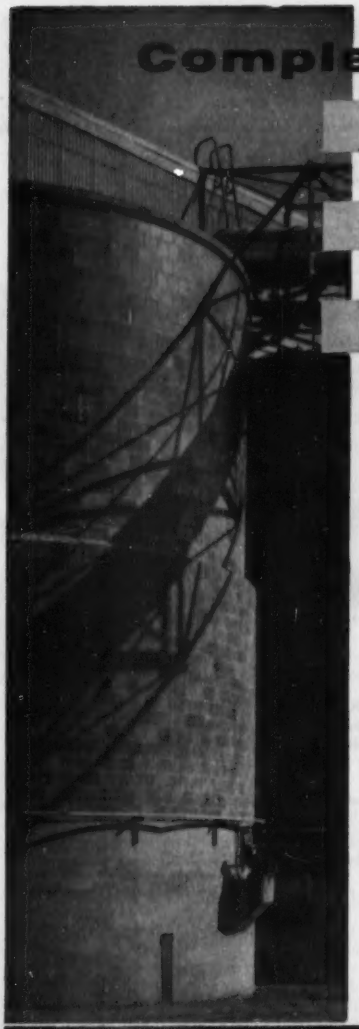

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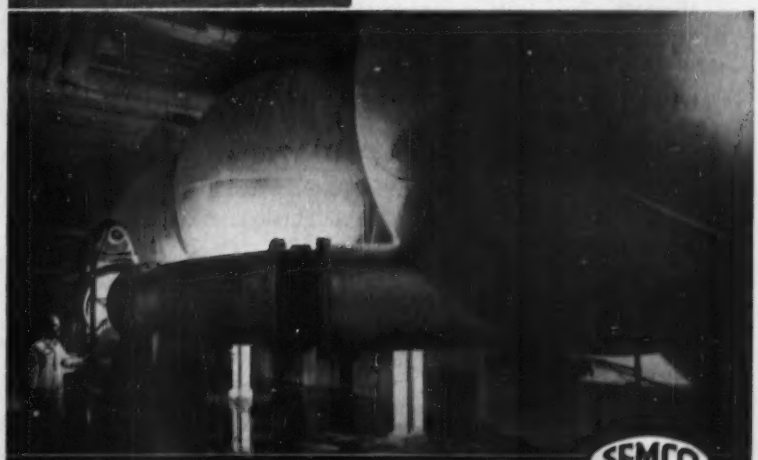

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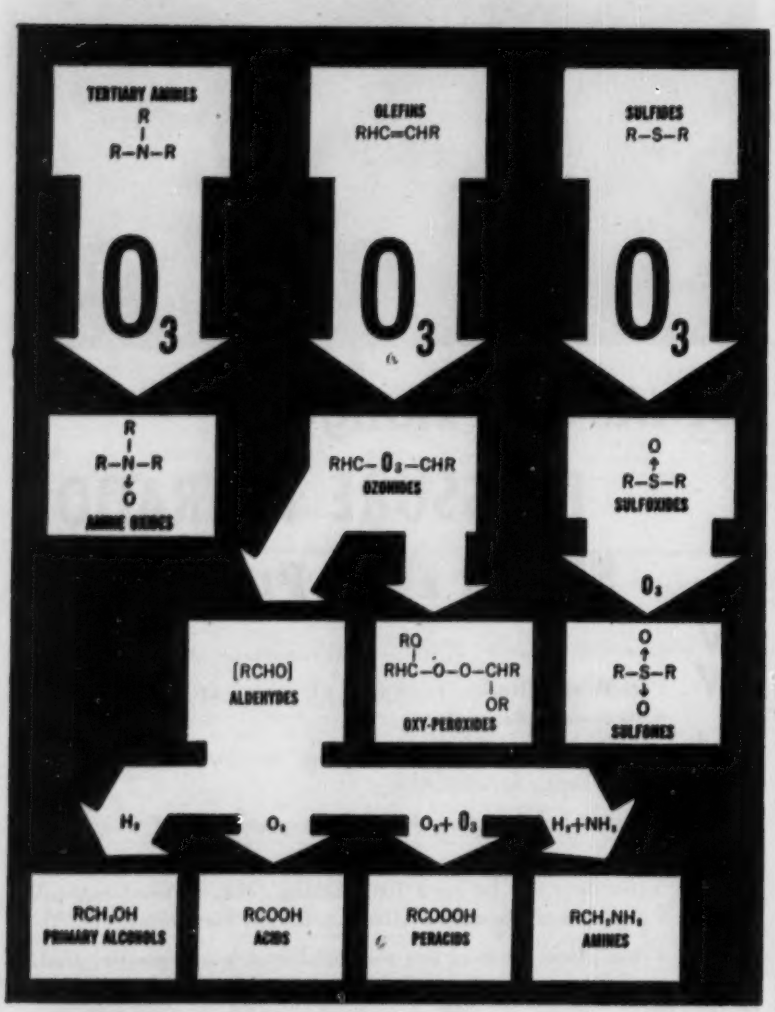

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470A Carbide & Carbon Chem.

Acetophenone.....8 p. technical bulletin gives properties, specifications, shipping containers, constant-boiling mixtures, & solubilities. Typical reactions are given & descriptions of its use. See Bulletin F-40,091.
470B Carbide & Carbon Chem.

Acids, Fatty, Polymerized.....New 20 p. booklet, titled "Empol 1022 Polymerized Fatty Acid" gives complete description, specifications, characteristics, considerable applications data and shipping data.
470C Emery Industries.

Acids, Organic.....Valuable 32 p. catalog describes several organic acids, their physical properties, specifications, test methods, including physical property charts & constant boiling mixtures. Catalog F-4768D.
470D Carbide & Carbon Chem.

Alcohols, Fatty.....Bulletin presents the unlimited possibilities of fatty alcohols as raw materials for further chemical reactions. Most important general reactions are included in Bulletin No. 907-R.
470E Archer-Daniels-Midland Co.

Alcohols, Fatty.....New 13 pg. bulletin includes reactions and preparations, data on saturated and unsaturated alcohols & tables of melting and boiling points. A complete list of references is included Bulletin 907-R.
470F Archer-Daniels-Midland Co.

* From advertisement, this issue

Literature

Alcohols, Fatty, Unsaturated.....Technical Bulletin describes "Unadol 90", essentially a mixture of 9, 12-Octadecadienol & 9, 12, 15-Octadecatrienol. Includes suggested uses, physical properties, specification range & solvents.
471A Archer-Daniels-Midland Co.

Aniline.....Offers aniline that exceeds A.C.S. specifications for CP aniline. Uniform quality assured by automatic instrumentation. Company will furnish a sample, specifications, price and delivery quotations.
313 *National Aniline Div.

Antioxidants.....Company offers 8 pg. pamphlet describing "Antioxidant AC-1", used in the petroleum field, in gasolines, jet fuels, waxes & oils. Includes applications, specifications, & physical properties.
471B Catalin Corp. of America.

Bromine.....29 pg. booklet, "Bromine", includes properties, methods of handling, detailed product characteristics, etc. Designed specifically for purchasing agents, chemists, handlers & users in industrial & research fields.
471C Dow Chem. Co.

Butyl Oleate.....Witco butyl oleate is a stable, non-volatile, oily liquid, which will not solidify under normal winter conditions. Description & information on properties contained in Technical Service Bulletin E-8.
471D Witco Chem. Co.

Catalysts.....New Girdler G-35 Catalysts retain outstanding physical properties even after repeated regenerations and use. Permit outstanding operational flexibility, continuous economical operation. Details.
301 *Girdler Co.

Catalysts, Ion Exchange.....12 p. booklet describes advantages of using ion exchangers as catalysts for epoxidation of unsaturated oils and olefins, hydration of ethylene oxide, esterification of alcohols. See Bulletin.
471E Permutit Co.

* From advertisement, this issue

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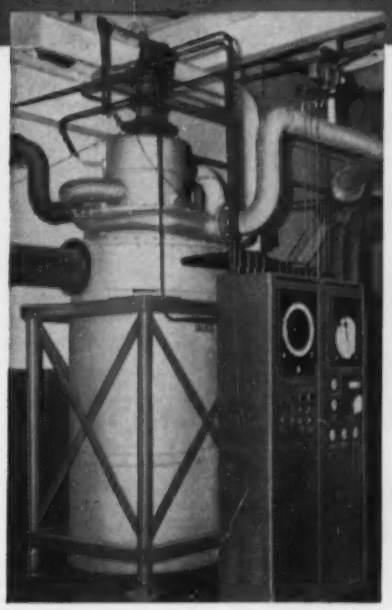

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LITERATURE . . .

Chemicals.....Company offers an up-to-date listing, with brief descriptions, of all its available chemical bulletins. This 4 p. compilation is accompanied by a blank for ordering desired bulletins. Ch-3.
472A Climax Molybdenum Co.

Chemicals.....Typical Harshaw chemical products: electroplating salts, anodes and processes; vinyl stabilizers; fluorides; glycerine; synthetic optical crystals; fungicides. Request 16 p. booklet.
298 *Harshaw Chem. Co.

Chemicals.....New 8 p. leaflet, "Neville Products to Make Your Products Better" covers company's full line of chemicals & contains data on the solubilities & compatibilities of Neville Resins. Request copy.
472B Neville Chem. Co.

Chemicals, Fine & Industrial.....Company offers latest comprehensive price schedule for fine and industrial chemicals. Also includes a price schedule for electronic chemicals, definition of grades & F.O.B. points.
472C J. T. Baker Chem. Co.

Chemicals, Heavy Metal.....Reference File shows heavy metal compounds Baker supplies in tonnage quantities, and quality grades available. Also contains availability charts of light metal compounds and acids.
236-7 *J. T. Baker Chem. Co.

Chemicals, Petroleum.....Olefins are used in production of quality resins for heavy-duty varnishes, in the manufacture of rubber chemicals, germicides, insecticides, dyes and surface active agents. Details.
275 *Atlantic Refining Co.

Chlorine Compounds.....Valuable 48 p. illustrated catalog describes organic chlorine compounds, their physical properties, solubility, specifications, shipping data, test methods, etc. Catalog F-4769B.
472D Carbide & Carbon Chem.

Cyanomolybdates.....Company offers a review, by Battelle Memorial Institute, of the more important physical and chemical properties of the cyanide complexes, cyanates and thiocyanates. Request Bulletin Cdb-11.
472E Climax Molybdenum Co.

Defoamers, Silicone.....Dow Corning "Antifoam B" disperses immediately in aqueous solutions. No stirring or agitation required. Ready to use & ideal for continuous processing. Request particulars and free sample.
R493 *Dow Corning Corp.

Degreasers.....Company offers brochure containing descriptive material on both Permacel 345 Degreaser and Permacel 340 Bite. Permacel 340 Bite is a new pre-paint cleaner and wax and silicone remover.
472F Permacel Tape Corp.

Dichlorophene.....Company offers a complete revised comprehensive bibliography of the literature on G-4 (Dichlorophene). Contains abstracts of scientific trade articles & of foreign & domestic patents. Technical Bulletin D-2.
472G Sindar Corp.

Elastomers.....Neoprene and Hypalon elastomers are used in improving products and cutting maintenance and replacement costs. Company offers "Neoprene Notebook" and "Facts about Hypalon."
73 *E. I. du Pont de Nemours.

Emulsions, Paint.....Bulletin covers physical properties, chemical and physical data, compounding properties, types of emulsions, formulations, instructions for use and trade names. Details in Form G101.
472H Shawinigan Resins Corp.

Enzymes.....Recently issued 24 pg. pamphlet enumerates the uses of the versatile enzyme "Papain" in industrial, medicinal and veterinary fields. Contains information on stability, assay, & chemistry.
472I S. B. Penick & Co.

* From advertisement, this issue

Esters, Maleic.....Technical Information includes physical properties, net container contents, copolymerization information, textile applications, miscellaneous reactions, & availability. Bulletin F-7354.
473A Carbide & Carbon Chem.

Finishes, Antistatic..... Technical information describes a new durable type antistatic finish for textiles, "Niatex" Antistatic Ag-2. Includes application procedures, physical properties, etc. Bulletin F-40021.
473B Carbide & Carbon Chem.

Formaldehyde.....Allied produces the basic raw material, methanol, at the same plant where the formaldehyde is made. Therefore, you can be sure of steady supply—and purity. Details on delivery, prices and services.
121 *Nitrogen Div., AC&D

Formaldehyde Solutions.....Celanese Formcels are low water content formaldehyde solutions in a variety of alcohols. Useful as organic chemical intermediates . . . for resin condensation reactions. Bul. S-23-5.
285 *Celanese Corp. of America

Furfural.....Furfural: selective solvent for refining petroleum fractions and rosin; extractive distillation agent for hydrocarbon separations; reactive solvent and dispersant for many resins. Bulletin 204.
400 *Quaker Oats Co.

Gases, Compressed.....Company announces new catalog & price list of its compressed gases & gas regulators. Includes special gas mixtures for instrument calibration, nuclear flow counters, furnace atmospheres, etc.
473C Matheson Co.

Glycols, Polyethylene.....Valuable 48 p. illustrated catalog describes "Carbowax" Polyethylene Glycols, their physical properties, industrial applications, shipping data, specifications, etc. Catalog F-4772B.
473D Carbide & Carbon Chem.

Greases..... Bulletin describes "Sun N-52X Grease", a stable, high-melt-point grease for bearings at temperatures up to 250 F, or for sealed anti-friction bearings used at normal temperatures. Bulletin 47.
473E Sun Oil Co.

Inhibitors, Corrosion.....A discussion of the possible use of slightly soluble molybdates in white & tinted inhibitive paints. A simplified procedure for estimating the corrosion inhibition. Bulletin Ch-25.
473F Climax Molybdenum Co.

Isotopes.....Company announces availability of literature describing in detail their services and facilities. Isotope measurement, fall-out studies, and radiocarbon dating are some of the services made available.
473G Isotope Products.

Isotopes, Stable.....Company offers a revised stable isotopes inventory and price list. Complete details of the sales and loan policy are contained in the new Stable Isotopes Catalog. Catalog F-80001.
473H Union Carbide Nuclear Co.

* From advertisement, this issue

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LITERATURE . . .

Latex . . . . . Newsletter describes Hycar 4501 Latex, its stabilizers & their effect on physical properties, foaming properties, effects of thickeners on viscosity & greaseproof coatings obtained by blending Hycar Latices.
474A B. F. Goodrich Chem. Co.

Molybdenum Boride Compounds . . . . . "Refractory Molybdenum Borides" is a 6 p. bulletin describing applications; chemical, physical and mechanical properties; and preparation of molybdenum boride compounds.
474B Climax Molybdenum Co.

Molybdenum Compounds . . . . . A collection of thermodynamic data for molybdenum and its oxides, sulfides, carbides, nitrides, silicides & halides. Includes oxidation-reduction potentials for various reactions. Bulletin Cdb-2.
474C Climax Molybdenum Co.

Monomers . . . . . New folder gives important properties and suggested uses for the 36 monomers that are available. Copolymer and polymer uses, & industries in which monomers are used included. Folder F-40033.
474D Carbide & Carbon Chem.

Monomers, Vinyl Acetate . . . . . New 20 pg. bulletin gives essential information on physical properties, grades, specifications & handling, details on polymerization & chemical reactions. All data fully referenced.
474E Air Reduction Chem. Co.

Nitrogen Solutions . . . . . New 48 p. handbook contains the most up-to-date nitrogen solutions technical data available. Describes chemical & physical properties, handling, storing information, etc.
474F Nitrogen Div. (AC&D)

Organolithium Compounds . . . . . Company offers Annotated Bibliography On the Use of Organolithium Compounds in Organic Synthesis. Original Bibliography and its Supplements are offered. Supplements 1, 2, 3, & 4.
474G Lithium Corp. of America.

Plasticizers . . . . . "Chlorowax LV—A Secondary Plasticizer for Vinyl Resins" describes the liquid chlorinated paraffin its properties & presents typical vinyl resin formulations & a 24-hour plasticizer exudation test.
474H Diamond Alkali Co.

Plasticizers . . . . . Up-to-date bulletin describes low temperature plasticizer, Plasticizer SC. Includes physical and chemical properties, data on use in Hycar, Chemigum, Paracril and Neoprene. Bulletin #06-72-3-5-56.
474I Harwick Standard Chem. Co.

Plasticizers . . . . . Technical Service Bulletin gives test recipe used & physical test data for Witco #20, a plasticizer for natural rubber tread stocks. Has Mooney Scorch time 25% longer than the Pine Tar recipe. Bulletin R-12.
474J Witco Chem. Co.

Polyphenyl, Chlorinated . . . . . Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; is non-corrosive. Request technical information.
169a *Monsanto Chem. Co.

Polyvinyl Materials . . . . . Products made from Geon rigid vinyl include corrosion-proof pipe, fume ducts, tanks, trays, materials that can be machined, planed, sawed, drilled, and cemented. Booklet on Geon 8700A & 8750.
9 *B. F. Goodrich Chem. Co.

Preventers & Removers, Scale . . . . . KETONE utilizes best features of polymerized phosphates and amino acid chelates to inhibit scale formation and dissolve and remove scale deposits. Request Technical Bulletin.
T504 *United Chem. Corp.

Resins . . . . . Company offers "Applications of Velsicol Resins in Rubber Compounding" treating the use of thermoplastic hydrocarbon resins. Covers physical & electrical properties, test data, etc. Bulletin 218.
474K Velsicol Chem. Corp.

* From advertisement, this issue

Resins, Tetrafluoroethylene.....Teflon tetrafluoroethylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & applications.
309 *E. I. du Pont de Nemours.

Sodium Lignosulfonates..... "Polyfon Technical Bulletin Number 303" describes use of sodium lignosulfonates as a binder for structural clay products. Describes 5 grades, their surface activity, wet & dry strength, etc.
475A West Virginia Pulp & Paper.

Sodium m-Silicate.....Valuable data on Drymet anhydrous—the most highly concentrated form of sodium m-silicate. Drymet File Folder contains complete technical information and suggested formulations.
B-08 *Cowles Chem. Co.

Sodiumo-Silicate.....New booklet discusses various metal cleaning & laundry applications of the chemical & presents physical & chemical properties, packaging & safety precautions. Form No. 126-8-556.
475B Dow Chem. Co.

Softeners, Rubber.....Technical Service Bulletin includes description of Witco #20 softener, giving physical properties, applications, and packing procedures. For complete information, request Bulletin R-11.
475C Witco Chem. Co.

Solvents.....Technical information describes "Ketosol" Solvent 75, a mixture of Acetophenone & Phenyl Methyl Carbinol, giving physical properties, solubilities, applications, etc. Request Bulletin F-7370A.
475D Carbide & Carbon Chem.

Solvents, Aromatic.....Cover a very wide evaporation range. Their individual characteristics satisfy specific requirements in a great variety of formulations. See, "Shell Aromatic Solvents for the Coatings Industry."
227 *Shell Oil Co.

Surface Active Agents.....Valuable 40 p. catalog describes Tergitol surface active agents, nonionic & anionic. Includes general properties, applications, physiological properties, performance data, etc. Catalog F-5900D.
475E Carbide & Carbon Chem.

Construction Materials

Alloys.....Monthly publication "Haynes Alloys Digest" includes articles on vacuum-melted alloy, service in handling molten glass, production of high-quality alloys, etc. For details, see Vol. 7, No. 9.
475F Haynes Stellite Co.

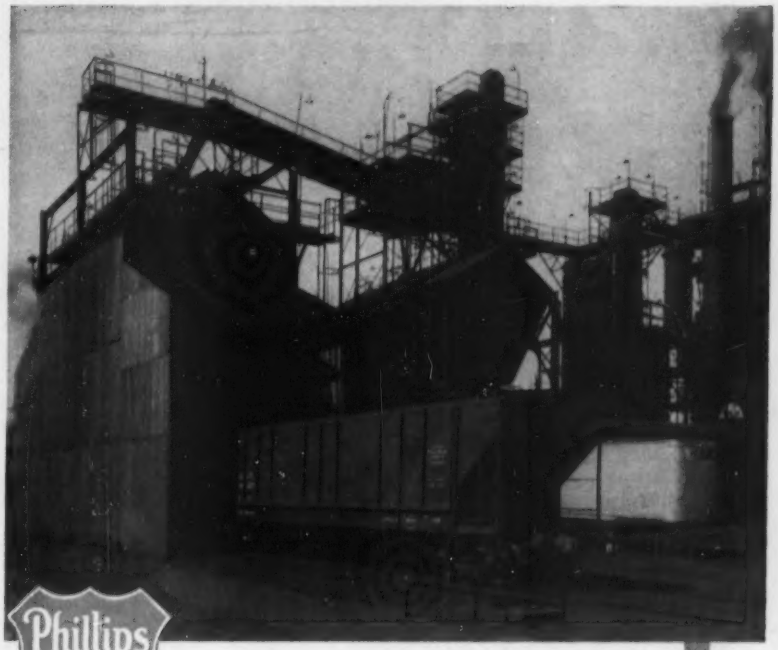
Aluminas, Hydrated.....Alcoa Hydrated Aluminas Series C-700 general-purpose pigments offer: fine particle size, uniformity, good mixing characteristics and substantial chemical neutrality. Request details.
159 *Aluminum Co. of America.

Aluminum.....Process Industry applications of aluminum for producing everything from beer to bomb shells are analyzed in illustrated, 80 p. book, "Process Industries Applications of Alcoa Aluminum."
160 *Aluminum Co. of America.

Aluminum..... "Reynolds Aluminum Digest", a 32 page monthly publication contains reviews of articles related to aluminum published the preceding 30-60 days. Contains summary of related current events.
475G Reynolds Metals Co.

Aluminum Bar Stock.....Illustrated 8 p. technical brochure "Hollow Aluminum Bar Stock" discusses tolerances, mechanical properties, and applications of the hollow machining stock. Request your copy.
475H Harvey Aluminum.

* From advertisement, this issue



Phillips 66

At Phillips Chemical . . .

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At its Borger, Texas Philblack plant, Phillips Chemical Company needed expertly-designed, precision-fabricated overtrack bulk storage for its carbon blacks. BOARDMAN — metalcrafting specialist — was commissioned to build these huge Berquist tanks to Phillips' specifications.

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Rock-anchored into the crags of the Santa Susana Mountains near Los Angeles crouch the massive test-stands of ROCKETDYNE – the most gigantic rocket engine workshop in the Western Hemisphere. The privileged men who tend these great power plants are a select group indeed. For no matter what their specialty, they are working at the most advanced state of their art.

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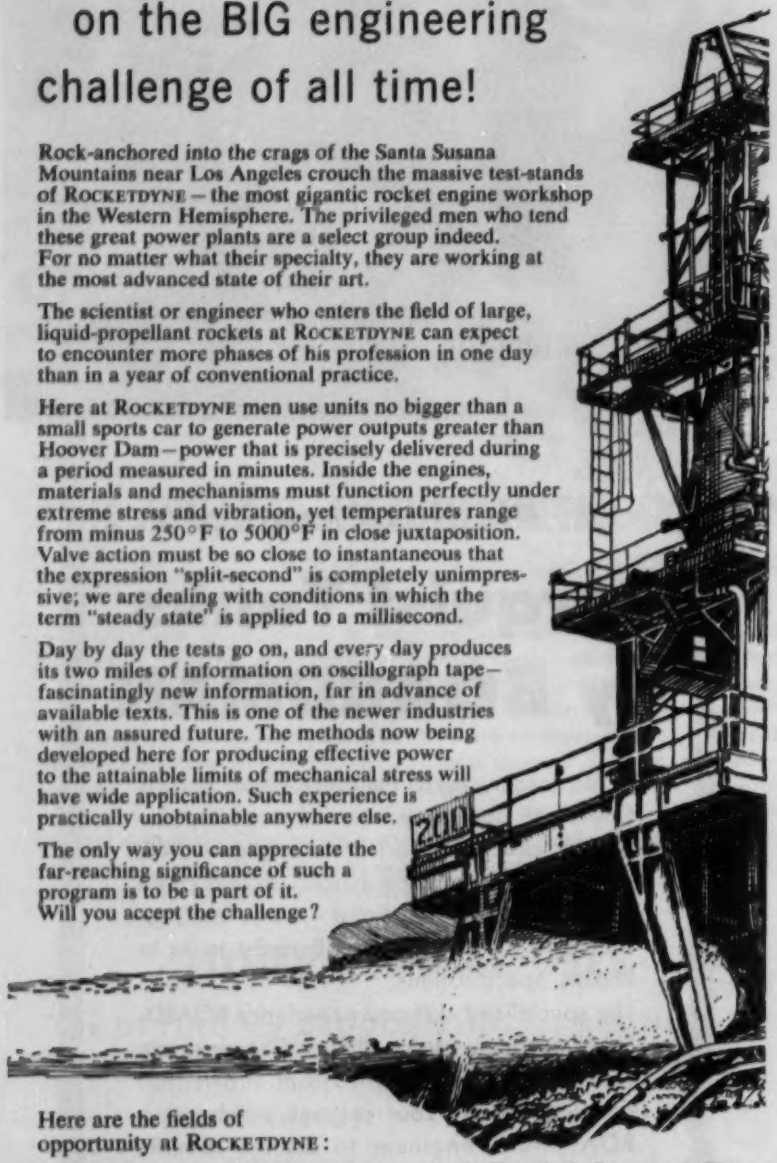
Day by day the tests go on, and every day produces its two miles of information on oscillograph tape – fascinatingly new information, far in advance of available texts. This is one of the newer industries with an assured future. The methods now being developed here for producing effective power to the attainable limits of mechanical stress will have wide application. Such experience is practically unobtainable anywhere else.

The only way you can appreciate the far-reaching significance of such a program is to be a part of it. Will you accept the challenge?



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BUILDERS OF POWER FOR OUTER SPACE

LITERATURE . . .

Coatings.....Company offers "Comparative Coatings Chart" illustrating the various resistances obtainable in comparing coatings made on various bases. Includes application data, properties, etc.
476A J. Landau Co.

Coatings, Protective.....Barrett Cold Coatings can protect cranes, conveyors, bridges, storage tanks. Offer outstanding resistance to moisture and chemical atmospheres. Request particulars, prices, literature.
257 *Barrett Div.

Coatings, Protective.....Helps you figure cost per sq. ft. per year of service for any coating system. Gives complete details on Phenoline 305 . . . system for longer protection against corrosion. Data Chart 1005.
391 *Carboline Co.

Coatings, Protective.....Tygorust & Tygon "ATD" are companion products to make your fight against corrosion less costly—more effective. You can get better protection. For the full story see "Tygon Painting Manual."
102 *U. S. Stoneware Co.

Coatings, Resistant.....4 p. illustrated bulletin describes 3 general classes of chemical-resisting organic coatings. Points out advantages of phenolic & plastisol Unichrome drum linings. Bulletin ChemC-2.
476B Metal & Thermit Corp.

Extrusions.....New 6 p. folder, covering extruded products, describes the facilities for production of tubular & solid shapes & explains the Ugine-Sejournet hot extrusion process. Request Folder TB-413.
476C Babcock & Wilcox Co.

Fabrication, Process Equipment..... Fabrication of the following in all standard types of metals: reactors, fractionating columns, heat exchangers, pressure vessels, agitators, kettles, tanks, coils, evaporators. Details.
28-9 *Brighton Corp.

Insulation.....New 4 p. 2-color brochure describes Gilsulate insulation for hot underground pipes. Discusses the problem of underground pipe insulation, application, & includes useful technical data.
476D American Gilsonite Co.

Insulation, Block.....Eagle-Picher PV Supertemp block insulation . . . with the new "precision-finish." A highly efficient, all-purpose insulating block that is practically dustless. Offers valuable product sample.
94 *Eagle-Picher Co.

Insulation, Pipe & Block.....12 p. gives full data on hydrous calcium silicate insulation for hot outdoor piping & process equipment operating at service temperatures up to 1200 F. Tells how Thermobestos is made. Illustrated.
125 *Johns-Manville.

Insulations, Industrial.....No matter where your insulation job may be—Armstrong can give you efficient, well-integrated, on-the-job service from original specs to final installations. Booklets describe full line.
273 *Armstrong Cork Co.

* From advertisement, this issue

Keeping too busy?

You'll find our streamlined Reader Service section right up your alley. It's designed for busy engineers who want to find things fast, get more information fast. RS is easy to use, and you can bank on it.

Jacketing Materials, Aluminum..... 40 p. manual, "Kaiser Aluminum Insulation Jacketing Materials & Methods," describes aluminum jacketing materials . . . details forming and application methods recommended.
24-5 *Kaiser Aluminum & Chem.

Lead.....Lead is relatively inexpensive, extremely durable, pliable and malleable. It is easily salvaged and the scrap value is usually a high percentage of original cost. Request Federated's Lead Handbook.
430 *Federated Metals.

Linings, Rubber.....Manhattan Rubber Linings are made from thick, multiple calendered sheets of natural or synthetic rubber that expand and contract with the metal under temperature changes. See Catalog 7115.
302 *Raybestos-Manhattan

Linings & Tile Tanks.....Designed & installed to meet the exact chemical & physical requirements of each installation. Stebbins linings & tile tanks are famous for their efficiency & economy. Request Bulletin A-153.
467 *Stebbins Engrg. & Mfg. Co.

Pillows, Polyethylene.....New one-page catalog sheet illustrates newly developed polyethylene pillows which reduce evaporation of liquids in open vessels up to 70%. Illustrations show design and application.
477A American Agile Corp.

Plastics.....New 15 p. illustrated catalog, entitled "Bakelite Plastics in the Home Building Industry", describes plastics for foundations, for framing, finishing, built-in equipment and for mechanical equipment.
477B Bakelite Co.

Plastics, Fluorocarbon.....New booklet covers entire family of Kel-F fluorocarbon products—plastics, dispersions, oils, waxes, greases, elastomers, printing inks and chemicals. Company makes booklet available on request.
149 *M. W. Kellogg Co.

Rods, Filler....."Ampco-Braz #1, '3-in-1' Filler Rod" describes a new low-fuming, high-strength, veratile nickel-brass rod for brazing & braze-welding with the oxy-acetylene process. Request Bulletin W-31.
477C Ampco Metal.

Rubber, Butyl.....Enjay Butyl comes in non-staining grades for white and light-colored parts, offers excellent electrical properties, low price and immediate availability. Full details available upon request.
231 *Enjay Co.

Rubber & Plastic Materials.....Piping, pumps, valves and tanks have a wide range of temperatures, pressure, impact resistance. For details about Ace rubber and plastic materials, request Technical Data CE-50.
396a *American Hard Rubber Co.

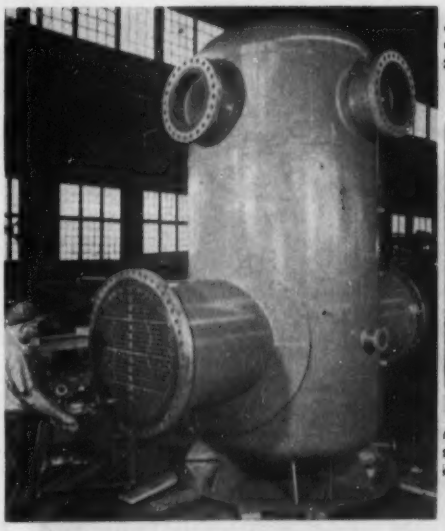
Steels, Rubber-Lined.....Ace rubber-lined steel . . . strength & pressures of steel plus chemical resistance of hard rubber. Excellent for alkalis, most inorganic acids, many organic acids, etc. Bulletin CE-52.
397d *American Hard Rubber Co.

Steels, Stainless.....Comprehensive 124 p. case-bound Stainless Steel Handbook helps select right stainless steel and indicates proper usage. Includes listings of analysis, properties, & characteristics of each type.
368 *Allegheny Ludlum Steel Corp.

Steels, Stainless.....Company offers informative 44 p. booklet, "Making the Most of Stainless Steels in the Chemical Processing Industries." Dozens of Crucible stainless grades are available to you now.
163 *Crucible Steel Co. of America.

Titanium.....Shows resistance to chloride solutions and retains useful strength up to 800-1000F. Other advantages and data on application and fabrication of titanium alloys in descriptive Rem-Cru Review.
92 *Rem-Cru Titanium.

* From advertisement, this issue



A Vilter 72"x14' vertical sub-cooler and de-superheater with a 42" x 12' horizontal fixed tube sheet.

A Vilter 84" diameter by 16' long high shell and coil accumulator used with ammonia.

Q. How would you efficiently remove 5,520,000 BTU per hour from circulating ammonia?

A. use a *Vilter* HEAT EXCHANGER that is carefully fabricated

and costs less to own*

Designed to do a big job are these typical Vilter heat exchangers. The vertical sub-cooler and de-superheater reduces the ammonia gas temperature and sub-cools the ammonia liquid. The design pressure for the shell side is 150 psig . . . and 250 psig for the tube side. This Vilter vessel cools 1332 pounds of ammonia gas per minute from 110° to 63° and cools 1150 pounds of liquid ammonia per minute from 102° to 60°. It has a capacity of removing 5,520,000 BTU per hour. Completely fabricated the vessel weighs almost 15 tons.

The Vilter high shell and coil accumulator, also shown, has 500 lineal feet of 2" O.D. Schedule 80 pipe coil arranged for liquid cooling. When completely fabricated this vessel weighs almost 13 tons.

Vilter has successfully resolved many problems of cooling under intense pressure, and has designed and produced thousands of heat exchangers and pressure vessels to exacting specifications for almost every type of application . . . working pressures as high as 10,000 psi. Vilter vessels are built in conformance to A.S.M.E., A.P.I., or T.E.M.A. standards.

The Vilter facilities include automatic welding, X-ray and Zyglo-Pentrex inspection. Vilter can design and produce highly efficient pressure vessels and heat exchangers required for a specific purpose. Consult with Vilter.

* Savings in low first cost are not the complete answer when considering the installation of refrigeration equipment. But savings in terms of years of extra service, reliable performance and minimum maintenance—that's where Vilter excels in low-cost ownership.

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ENGINEERING DESIGN that guarantees performance

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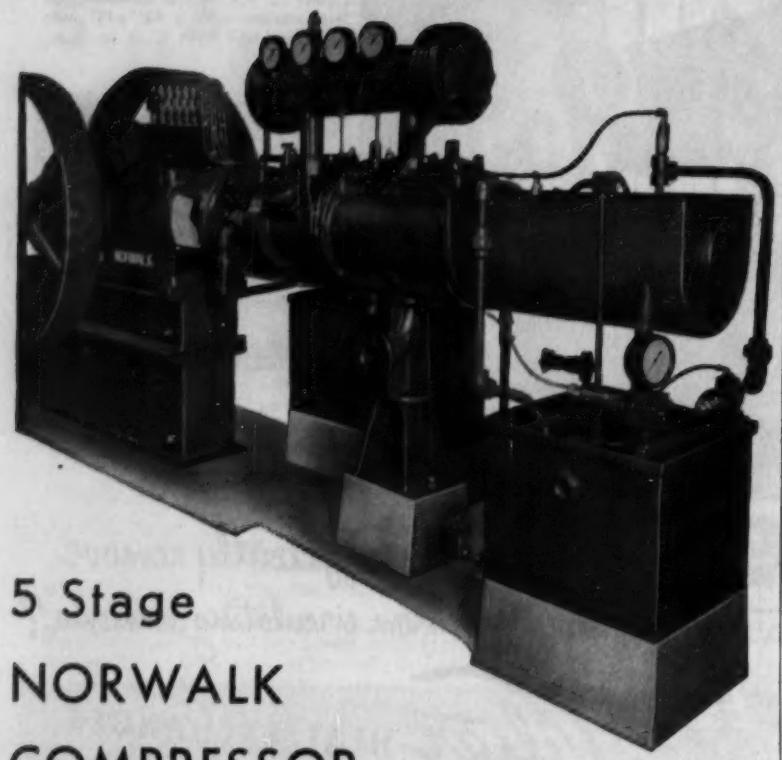
Air Units • Ammonia & Freon Compressors • Booster Compressors • Bandaid Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines



5 Stage
NORWALK
COMPRESSOR

built for economical performance

Frames with taper roller bearings, reversible ring plate valves force feed lubrication, generous intercooler coils are some of the features that make this horizontal duplex compressor compact, sturdy, and efficient to operate. Its five stages develop 7500 pounds pressure.

Every Norwalk compressor is test-run for eight hours at the factory, then taken down for complete inspection before re-assembly and shipment. Complete catalog describing compressors from single stage to six stages available on request.

NORWALK COMPANY, INC.
SOUTH NORWALK, CONNECTICUT

Makers of high pressure compressors since 1864

LITERATURE . . .

Tooling, Plastic.....“The Marblette Digest of Plastic Tooling” summarizes existing applications of plastic tooling for metal-forming & plastics-forming & in foundry practice. Describes various thermosetting materials.
478A Marblette Corp.

Wrappings, Protective.....Bulletin describes new protective plastic coating developed for use on acid-carrying pipe lines. The coating serves as a mechanical reinforcement for the pipe. Request Bulletin #9010.
478B Bakelite Co.

Electrical & Mechanical

Bearings, Roller.....Bulletin gives load ratings, dimensions and other data on Dodge-Timken Roller Bearings. Offer superior performance, dependability and long life. Delivered fully assembled, ready to mount. Bul. A628.
156 *Dodge Mfg. Corp.

Casters & Wheels.....Featuring Darnel-loprene treads (a soft resilient Neoprene rubber compound) . . . casters offer ease of movement, quietness, and protection for floors. See Manual for details.
B497 *Darnell Corp.

Chains, Electrolized.....Company offers a concise & readily understandable folder in a question & answer form on electrolized roller chain. Discusses corrosion resistance & gives advantages of electrolized chain.
478C Atlas Chain & Mfg. Co.

Chassis Slide Assemblies.....Chassis-Trak's new “Easy-Mount” chassis slide assembly (Model CTEM) simplifies mounting of electronic equipment in cabinets or racks. Further information available upon request.
478D Chassis-Trak Corp.

Clutches.....Unique type clutch, possessing exclusive “lock-in” toggle action, offered by Salsbury Corp. Tog-O-Loc Clutch has disengagement speed approximately 400-500 rpm lower than engagement speed. Bul. 56-D-2.
478E Salsbury Corp.

Contacts, Electrical.....New 28 p. catalog, “Baker Electrical Contacts” details contact materials, material characteristics, types of contacts and applications to industry. Presents numerous designs.
478F Baker & Co.

Converters, Torque.....New bulletin describes Twin Disc's new 1500 Series Single-Stage Torque Converter. Contains illustrations & tables on converters fluid circuit, horsepower & rpm capacity. Bulletin 508.
478G Twin Disc Clutch Co.

Drives.....Describes the Cleveland Speed Variator—a simple, compact drive that provides infinitely variable output speed over a range up to 9:1 from a constant speed power source. Illustrated Bulletin K-200.
12 *Cleveland Worm & Gear Co.

Expanders, Tube.....New 32 p. catalog contains complete specifications of entire product line of Ideal Tube Expanders and Cutters, plus necessary information pertaining to a line of Operating Accessories. Catalog 81.
B508 *Gustav Wiedeke Co.

*From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the product.

Gear Sets, Worm.....Company offers complete catalog of ratings and dimensional data on Worm Gear Sets. Standardization and quantity production make standard and special worm gear sets possible. Manual SW-1.
166b *Foote Bros. Gear & Mach.

Gears.....Longer life Duti-Rated gears are specially heat-treated for increased tooth surface hardness and produced to high precision tolerances. Complete information and technical data available in Manual DR-2.
166a *Foote Bros. Gear & Mach.

Magnets, Perma-Plate.....New Dings dynamic way to remove tramp iron from rapidly moving material. Perma-Plate Magnets for better magnetic separation in chutes, spouts, ducts. Request Catalog 1205-D.
485 *Dings Magnetic Separator Co.

Motor Starter-Circuit Breakers.....Design, construction & performance of circuit breaker & motor starter Unilets give maximum safety & unparalleled ease of wiring, installation, maintenance. Bulletin BH.
307 *Appleton Elec. Co.

Motors..... "Synchronizer" contains articles on use and application of E-M Synchronous Motors. Includes motor maintenance chart, information on motor upkeep, etc. Vertical Motor Number 200-SYN-43.
479A Electric Mach. Mfg. Co.

Motors.....New Elliott C-W Dripproof Motor provides best in mechanical protection, best in insulation, best in bearings, best in rigid construction. Company makes complete details available in new booklet.
91 *Elliott Co.

Motors.....Motors to power your pumps, agitators, compressors and blowers. Offers diversified line of standard motors, from 1/6 to 500 hp, readily adapted to your requirements. For complete information-Bulletin MU135.
62 *Wagner Elec. Corp.

Motors.....Reuland Flexi-Shaft motor provides new fluid-drive principle—use of steel shot instead of a true fluid. Features smooth load acceleration, protection against equipment jamming. Request literature.
479B Reuland Electric Co.

Motors, Vertical.....Company offers information describing a newly designed vertical solid shaft motor, conforming to dimensional standards recently adopted by NEMA. Describes operation, features, etc.
479C U. S. Elecl. Motors.

Packings, Teflon....."Teflon" is used because it is impervious to any known industrial acids and caustics; has no known solvent; has zero water absorbtion; is unaffected by weather. "Teflon" Accessories booklet.
402 *Raybestos, Manhattan.

Packings, Teflon.....For all-chemical service "Chemiseal" Teflon packings ...extremely antiheisive... requires no lubricant...lasts for months in service where other packings fail in hours. See Bulletin T P-1155.
413a *U. S. Gasket Co.

Packings, V-Ring....."Pressure-Sealing" V-Ring packings can be used for all reciprocating rods and valve stems handling water, oil, solvents, steam, air and gas. For complete details, request Catalog 4-R-10.
413b *U. S. Gasket Co.

Seals, Lubricated.....Chempro Seals give highly economical service on pumps handling acids, alkalis, solvents and other chemical liquids and slurries under diverse operating conditions. See Bulletin 551.
423 *Chemical & Power Products.

Seals, Mechanical....."John Crane" Seals, specially engineered for the Chemical Industry, eliminate loss of expensive and corrosive fluids. Company makes further information available in seal catalog.
393 *Crane Packing Co.

*From advertisement, this issue

—Dredge Mining in South Carolina

speaking of heavy minerals....

VITRO'S across-the-board position in atomic energy and related technologies gives it unusual insight into untapped industrial potentials. From this vantage point, it has diversified into rare earths and heavy minerals through association with Crane Co. in the operation of Heavy Minerals Co.

Heavy Minerals owns large deposits of source materials for thorium, titanium, zirconium, and rare earth ores near Aiken, S. C., and Panama City, Fla. A processing plant under construction at Chattanooga, Tenn., will produce thorium and thorium compounds, misch metal, rare earth chemicals, zirconium compounds and related products. Pechiney of France, holder of many patents in rare earths and heavy minerals, retains a minority interest in the company.

Heavy Minerals' deposits contain a number of heavier rare earths including europium, gadolinium and yttrium, many of which are considered important in nuclear development.

There are many projected uses for these products in the field of nuclear applications for control and shielding, x-ray sources, capacitors, vacuum tubes, television color tubes and catalytic reactions. New and unique production processes by Heavy Minerals Co. make these products available in separated forms at high purities and greater quantities.

For detailed information write **HEAVY MINERALS CO.**, *an associated company of*

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CORPORATION of AMERICA

261 Madison Ave., New York 16

Research, development, weapons systems
Nuclear and process engineering, design
Refinery engineering, design, construction
Uranium mining, milling, processing, refining
Rare metals, rare earths, heavy minerals
Ceramic colors, pigments, fine chemicals

to meet your specialized needs . . .

A COMPLETE LINE OF

Arnold O. Beckman INC.

OXYGEN ANALYZERS!

For time-saving, *accurate* measurements of Oxygen in your process or laboratory operations, select from the complete range of Oxygen Analyzers offered by Arnold O. Beckman, Inc.

Each instrument operates on the field-proven Arnold O. Beckman *paramagnetic* principle which makes a direct physical measurement on the Oxygen itself. No chemicals, no complicated secondary relationships are used!

MODEL D2—Spot-checks on purged tanks, lines, or flue gas are done quickly and conveniently with the Model D2. This unit is completely self-contained, battery-operated and weighs only 3½ lbs. Operation is simple—merely squeeze a bulb to draw sample into the Analyzer, press a switch, and observe the O_2 concentration indicated on the graduated scale. Available with either 0-25% O_2 (0-190 mm) or a 0-100% O_2 (0-760 mm) dual range, the Model D2 accurately performs to ±2% of full scale.

MODEL C—For higher accuracy with narrower ranges (than available with the D2), the Model C will meet your more advanced needs. Select almost any single range 0-5%, 0-10%, 16-21% 85-100% O_2 etc. (or equivalent in mm O_2 partial pressure). Accuracy is ± 1% of full scale. A 95% response to any reading is obtained in less than one minute. Oxygen content is read directly from a graduated scale. Measurements may be taken on either continuous or fixed volume samples. 115 Volts 50/60 cycles. Weight: 12 lbs.

RECORDING ANALYZERS—For continuous, automatic operation, Models F3 and G2 Analyzers provide millivolt, current, or pneumatic output for operation with standard recorders. Ranges from 0-0.1% O_2 to 0-100% O_2, 16-21%, etc. Multiple ranges, explosion-resistant cases, as well as complete sampling systems are available extras with the Models F3 or G2.

MODEL E2—The precision-designed Model E2 fits the needs of installations requiring maximum accuracy. Offering a choice of single or multiple ranges, the Model E2 provides quick, easy readings when a potentiometer dial is manually adjusted to restore a light beam to its null position. Oxygen content is read directly from the dial. Minimum range 0-1% O_2 with accuracy of ± 1% of full scale. Ranges 0-5% O_2 and wider . . . accuracy ± 0.5% of full scale. 115 volts 50/60 cycles. Weight: 31 lbs.

FOR MORE INFORMATION—Outline your particular problems and let Arnold O. Beckman's experienced engineers offer recommendations for your specialized needs. Bulletins on any and all of the Arnold O. Beckman Analyzers are yours for the asking.

For General Information, Ask for Data File 21X-116

Arnold O. Beckman

Profit Builders for Industry

1020 MISSION STREET

SOUTH PASADENA, CALIFORNIA

LITERATURE . . .

Switches, Pressure.....New pressure switch, 9622 or C9622, can sense two different pressures in one system and actuate independent electrical circuits at any two desired points. Information available upon request.
480A Barksdale Valves.

Transmission Machinery, Power..... Dodge 1956 Engineering Catalog discusses full line of power transmission machinery—base plates, clutches, couplings, sprockets, engineering data, pulleys, etc.
480B Dodge Mfg. Corp.

Handling & Packaging

Belts, V.....Veelos adjustable v-belts assures faster, cleaner work, less vibration, cooler running, greater flexibility & simple installation. Veelos Data Book contains valuable engineering data.
295 *Manhein Mfg. & Belting Co.

Conveyors..... New brochure describes Prab's bucket elevators, screw conveyors, and vibrator combination. Units are designed to handle abrasive materials such as sand, chemicals, grains, etc. Brochure P-30.
480C Prab Conveyors.

Conveyors, Bag.....Versatile new flat belt bag conveyor features variable belt speeds and adjustable frame to meet variety of conveying requirements. Company makes further information available upon request.
480D Richardson Scale Co.

Conveyors, Lift.....New bulletin describes how the Rapistan Vertical Lift Conveyor can replace costly elevators, save space & the time & cost of an elevator operator. Request copy of Form 1400-56.
480E Rapids-Standard Co.

Delivery Systems, Bulk.....Company offers information on Superior Bulk Delivery Systems, giving greater payloads, discharge rate, safety and profit. Includes specifications and diagrams.
480F Superior Separator Co.

Dockboards.....Company offers 4 p. two-color catalog covering their complete line of HI-LO Automatic Dockboards. Explains & diagrams the HI-LO features for both recess & packaged models. Catalog D-160.
480G Kelley Co.

Drums, Magnetic.....Eriez Permanent Magnetic Drum can be used for automatically extracting tramp iron from materials conveyed in spouts, chutes, spiral conveyors, etc. For more information, request Bulletin B-601.
480H Eriez Mfg. Co.

Feeders.....Prater offers Blow-Thru Feeder for pneumatic systems. Available in cast iron and bronze. Power requirements vary according to the fineness and abrasiveness of the product. New Airlock Catalog.
408 *Prater Pulverizer Co.

Feeders, Wet Reagent.....Accurately meter minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Data in Bulletin F6-B9.
420e *Denver Equipment Co.

*From advertisement, this issue.

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

Handling Equipment, Chlorine.....New literature illustrates & describes such chlorine handling equipment as: liquid chlorine evaporators, valves & fittings for chlorine liquid & gas supply lines, etc. Catalog 56.100.
481A Wallace & Tiernan.

Hortonspheres.....Hortonspheres are designed for the storage of such liquids as anhydrous ammonia, butadiene, and other volatile liquids, are available in sizes to 30,000 bbls. Request complete information.
127 *Chicago Bridge & Iron Co.

Magnets.....“Magnetic Ideas From Eriez” contains case histories explaining how various firms use permanent, non-electric magnets to prevent iron contamination in their products. Illustrated, 24 p. Brochure B-213.
481B Eriez Mfg. Co.

Materials Handling, Bulk-Flo.....Equipment designed to reduce handling costs on wide range of materials. Features ability to feed, convey, elevate in one compact, fully enclosed assembly. 28 p. Book 2475.
13 *Link Belt Co.

Packaging Materials.....“Packaging and Carloading Guide,” a 48 p. booklet tells how to package and carload for maximum product protection at minimum cost. For complete information, request Catalog No. 17.
481C Signode Steel Strapping Co.

Scales, Bagging.....New 2-color, 6 p. bulletin describes the design, performance, & features of a new automatic bagging scale, designated as GA-38. Includes construction, components, etc. Bulletin No. 0156.
481D Richardson Scale Co.

Scales, Shipping.....4 p. two-color bulletin describes automatic bulk grain shipping scale for the rapid weighing of all free-flowing grains. Describes operation, recording features, etc. Bulletin 4049A.
481E Richardson Scale Co.

Storage Equipment, Chemical.....Lightweight, nonconductive, temperature-resistant tanks by Beetle have proven tops at beating costly chemical corrosion problems. Company offers fully descriptive literature.
422 *Carl N. Beetle Plastics.

Supports, Cable.....P-W bulletin describes cable trough & accessories for holding cables for all industries. Describes channel, extension & adjustable connectors for any change in direction or elevation. Bulletin 256-F.
481F P-W Industries.

Tractor-Shovels.....The HA “Payloader” & the larger model HAH do the work of 4 previous units. Ideal for any bulk materials you have to scoop-up, carry, load, dump, stockpile or spread. Request literature.
367 *Frank G. Hough.

Trailers, Industrial.....2 p. two-color bulletin describes & gives full specifications for Models A-614 & A-443, heavy & extra-heavy duty trailers, of 10 ton & 30 ton capacity respectively. Bulletin TR-103.
481G Mercury Mfg. Co.

Trucks.....New 8 p. catalog describes company’s complete line of electric powered “Walkie” truck models. Covers, in concise form, capacity and dimensional specifications, construction details, etc.
481H Moto-Truc Co.

Trucks, Fork.....New 20 p. illustrated catalog describes in detail the latest in the Master Line of Lewis-Shepard Fork Trucks. Outlines features of new “E” truck, pointing out advantages, etc. Request your copy.
481I Lewis-Shepard Prod.

Trucks, Fork.....Construction details, operating characteristics & maintenance features of the new Clarklift line of fork trucks are described in a 16 p. three-color brochure, titled “Clark-lift Features”.
481J Clark Equipment Co.

*From advertisement, this issue.

Just push one knob

TO UNLOAD THIS CENTRIFUGAL

That’s all you do, and the plow swings out to the side of the basket . . . plows down the basket side . . . travels back and then swings out of the way. Solids meanwhile discharge quickly through the bottom. For this is the new Tolhurst Batch-Master® Centrifugal – which combines quick discharge with the greater stability of Center-Slung® Suspension. It needs no more headroom than a man, requires no center spindle from above.

Batch-Master offers a choice of perforate and imperforate baskets. . . corrosion-resistant materials . . . manual unloader if desired. “All-speed” drive lets you select the best speed for loading, spinning, unloading. Send for 4-page bulletin.

MAIL COUPON TODAY

Tolhurst CENTRIFUGALS

A DIVISION OF

American Machine and Metals, Inc.

Specialists in liquid-solids separation

Dept. CET-1156, EAST MOLINE, ILLINOIS

Send your new free 4-page Bulletin TC-14-56 giving full data on Batch-Master Centrifugal.

NAME AND TITLE

COMPANY

ADDRESS

CITY ZONE STATE

put **pep** in a **tired** oil well

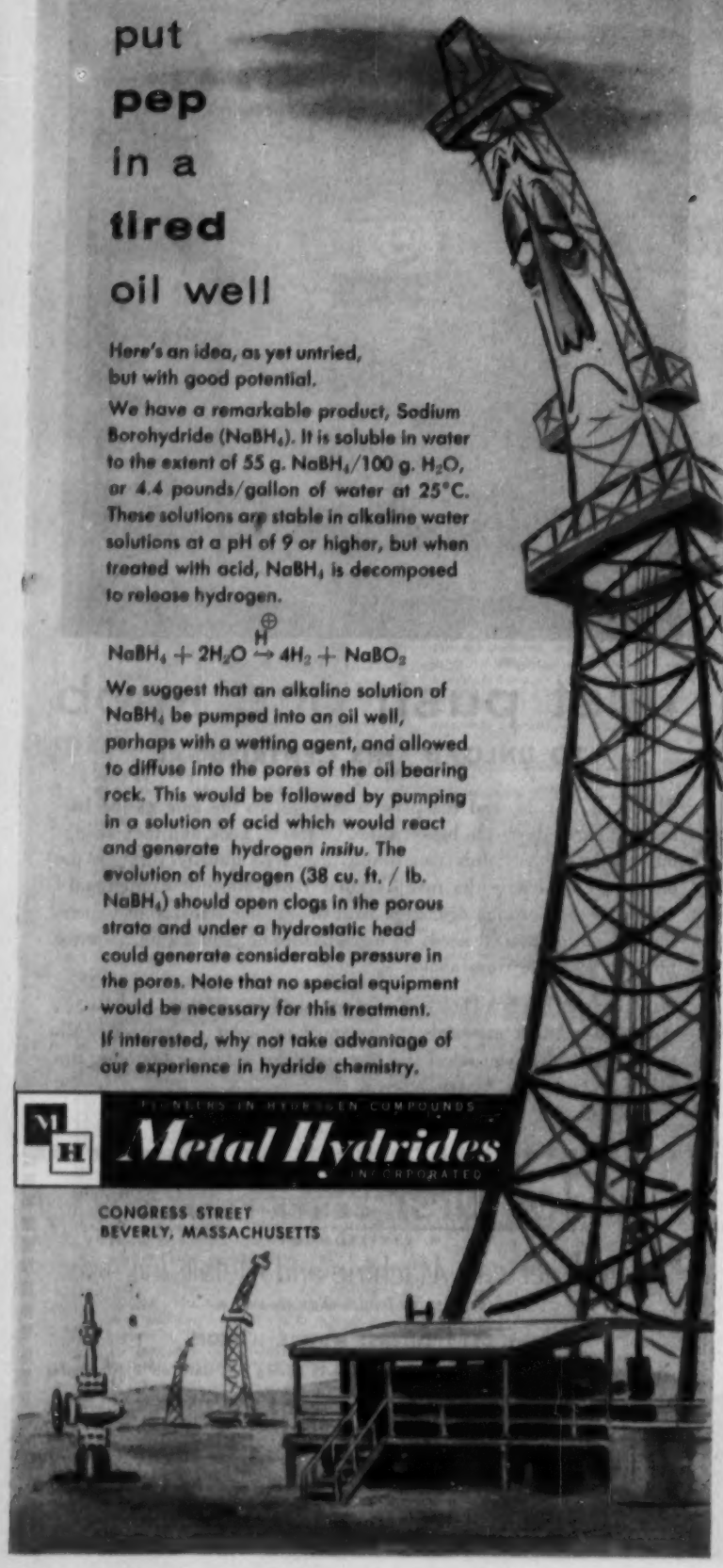
Here's an idea, as yet untried, but with good potential.

We have a remarkable product, Sodium Borohydride ($NaBH_4$). It is soluble in water to the extent of 55 g. $NaBH_4$/100 g. H_2O, or 4.4 pounds/gallon of water at 25°C. These solutions are stable in alkaline water solutions at a pH of 9 or higher, but when treated with acid, $NaBH_4$ is decomposed to release hydrogen.

$$NaBH_4 + 2H_2O \xrightarrow{H^{\oplus}} 4H_2 + NaBO_2$$

We suggest that an alkaline solution of $NaBH_4$ be pumped into an oil well, perhaps with a wetting agent, and allowed to diffuse into the pores of the oil bearing rock. This would be followed by pumping in a solution of acid which would react and generate hydrogen *insitu*. The evolution of hydrogen (38 cu. ft. / lb. $NaBH_4$) should open clogs in the porous strata and under a hydrostatic head could generate considerable pressure in the pores. Note that no special equipment would be necessary for this treatment.

If interested, why not take advantage of our experience in hydride chemistry.



MH — Metal Hydrides INCORPORATED

PIONEERS IN HYDROGEN COMPOUNDS

CONGRESS STREET
BEVERLY, MASSACHUSETTS

LITERATURE . . .

Trucks, Fork Lift......"Greater Maneuverability and Faster Handling With Tow-motor Power Steering" illustrates and describes low cost, improved features of Towmotor fork lift trucks. Describes operation.
482A Towmotor Corp.

Vessels, High Pressure.....Cole can build you the kind of high-pressure tanks or vessels you require . . . any size, any shape, any metal. For complete product information, request copy of catalog, "Tank Talks."
T500 •R. D. Cole Mfg. Co.

Vibratory Equipment.....Electro-permanent magnetic Hi Vi vibratory equipment needs no recifier. Operates at 3600 CPM directly off an AC line. Units are automatically self-adjusted. Request data.
482B Eriez Mfg. Co.

Warehouses.....Company announces the availability of a new 8 p. application analysis on materials handling in grocery warehouses. Includes descriptions & illustrations. Request analysis #152.
482C Lewis-Shepard Products.

Weighing, Industrial ..... Company makes available a Check-Chart through which weighing information can be assembled quickly. Kit includes instructions, relationship of weighing to cost, etc.
482D Toledo Scale Co.

Heating & Cooling

Burners, Dual Stage.....Oil burners of the steam and mechanical types now combined into dual stage burners. For the detailed description, illustration and specifications, Bulletin 35 is available on request.
L491 •National Airoil Burner Co.

Cables, Electric Heating.....Bulletin describes Chromalox "Hi-Temp Thermwire" electric heating cable, which provides a flexible, high temperature heat source for application temperatures up to 275 F. Bulletin L-1138.
482E Edwin L. Wiegand Co.

Chillers, Water....."Cold Generator" bulletin covers company's line of 10 through 150 hp packaged, reciprocating water chiller units for industrial & commercial, comfort or process applications. Bulletin Ds-352.
482F Trane Co.

Coils, Heating & Cooling.....Stainless—Continuous plate type with staggered tubes and smooth drawn ferrules pressure-expanded to produce effective positive mechanical and thermal bond between tube & fin. Data.
363c •Marlo Coil Co.

Condensers, Evaporative.....Stainless—2—150 tons. Suitable for indoor or outdoor location. Quiet operating. All prime surface condensing coil. Available to your specifications. Request further information.
363d •Marlo Coil Co.

Evaporation.....12 p. brochure, "An Open Door" tells about unit operations such as evaporation, crystallization, filtration, pulp washing & spray drying as a means to reduced costs & improved quality.
482G Swenson Evaporator Co.

Evaporators, Film.....Company offers wiped film evaporator in 2" glass model and in these diameters of stainless steel: 12", 24", 36", 48" and 60". Also available in monel, hasteloy, nickel, etc. Details.
482H Pfaudler Co.

Heat Exchange Equipment.....Applications include polyacrylonitrile and acrylic copolymers, viscose (rayon and cellophane), cellulose acetate, cellulose ethers and polyesters. For details, request Bulletin V248.
2 •Girdler Co.

•From advertisement, this issue

Heat Exchangers.....New bulletin contains data & illustrations of interest to designers & users of custom-built heat transfer equipment. Describes a number of available heat exchanger types. Request Bulletin HE.
14 *Downingtown Iron Works.

Heat Exchangers.....Distributes Delanium Graphite Block Type Heat Exchangers for Powell Duffryn Carbon Products Ltd. of Hayes, England. Applications as condensers, evaporators, heat exchangers. Cat. 456.
483A Delanium Graphite Co.

Heat Exchangers.....Aero heat exchanger cools liquids & gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. Bulletins 120 & 124.
414 *Niagara Blower Co.

Heat Exchangers.....Describes Type "SSF" stainless steel heat exchangers for heating or cooling liquids & gases as used in industries where elements of corrosion to alloys are encountered. Catalog No. 1155.
462 *Young Radiator Co.

Heat Exchangers, Acid Resistant..... Important data on Swenson type of tube mounting, types of corrosion resistant materials available and advantages of neoprene ring gaskets in "Acid Resistant Heat Exchangers."
483B Swenson Evaporator Co.

Heat Transfer Systems.....Capacities can range from small portable units to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Request names of designers & manufacturers.
169b *Monsanto Chem. Co.

Heaters.....Company offers bulletin describing Down Flow Unit Heaters, giving features, specifications, basic steam, hot water & quietness ratings, conversion factors, dimensions, etc. Catalog No. 762.
483C McQuay, Inc.

Heaters, Circulation.....New 8 p. bulletin describes Chromalox automatic electric circulation heaters, for controlled heating of water, oils, heat transfer media, steam, air and other gases. Request Bulletin 701.
346 Edwin L. Wiegand Co.

Heaters, Circulation.....Bulletin presents Case Studies concerning the use of Chromalox electric heaters. Include cases of the heating of fuel oils, oil, steam, water, air & other gases. Bulletin F-1587.
483D Edwin L. Wiegand Co.

Heaters, Far-Infrared.....Bulletin describes Chromalox Adjustable Area Far-Infrared Heaters. Includes description of features, accessories, information on how to install type Rutu Elements, etc. Bulletin CS-607.
483E Edwin L. Wiegand Co.

Heaters, Gradiation.....Makes available detailed literature—"Try the Gradiation Heater for Economical Ethylene Production" and bulletin, "Gradiation Heating for Petroleum and Chemical Processing."
354 *Selas Corp. of America.

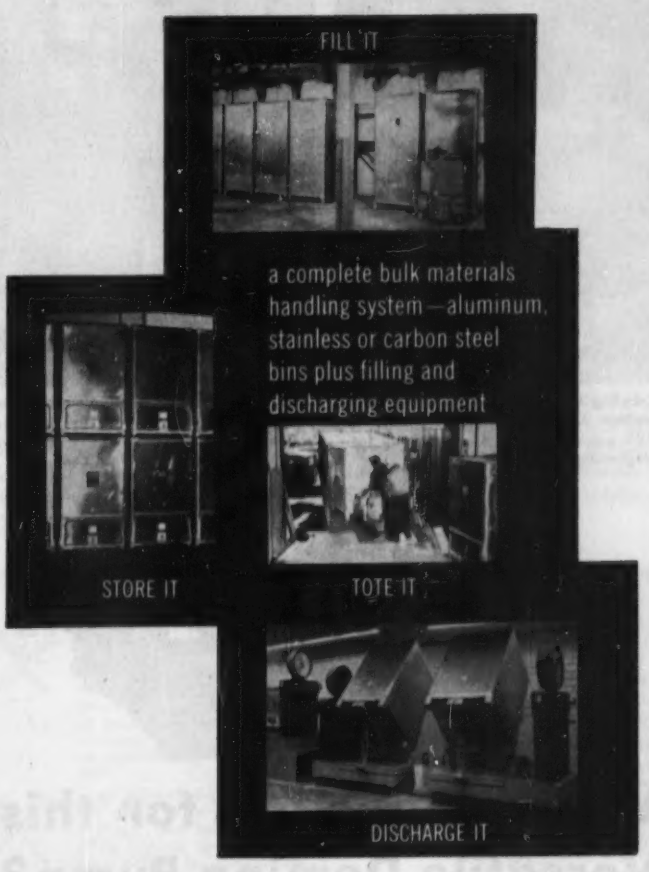
Heaters, Unit.....Grid unit heaters feature trouble-free heating service in the major chemical plants for over 25 years—no maintenance or repairs. Get the full story on Grid unit and blast heaters and radiation.
R499 *D. J. Murray Mfg. Co.

Heating Systems, Dowtherm.....Furnishes descriptive information on Dowtherm heating systems for processes requiring precision control of high constant temperatures at low pressures, in Bulletin ID-54-5.
151 *Foster Wheeler Corp.

Heating Units.....48 p. catalog describes Chromalox Electric Heating Units and Equipment. Contains data on heating elements, immersion elements, tank immersion heaters, water circulation heaters, etc. Catalog 50.
483F Edwin L. Wiegand Co.

*From advertisement, this issue

TOTE SYSTEM*


FILL IT
a complete bulk materials handling system—aluminum, stainless or carbon steel bins plus filling and discharging equipment
STORE IT
TOTE IT
DISCHARGE IT

first...

- To bring you a new, more efficient method of bulk materials handling
- In number of installations
- In sanitation
- In flexibility
- In compactness
- In savings
- To offer the CONTAINER CAR which simply and cheaply solves bulk delivery problems of off-rail users

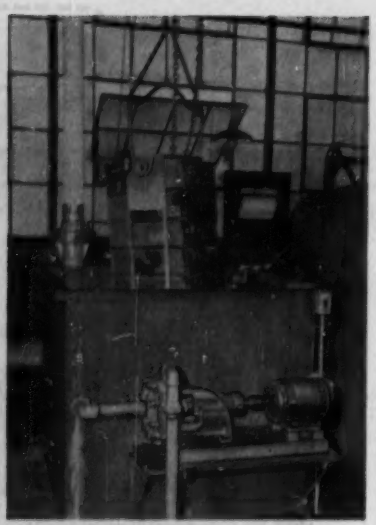
Want to know how Tote System fits your picture? Write for illustrated literature, or ask for a survey by Tote engineers. No obligation.

TOTE SYSTEM, INC.

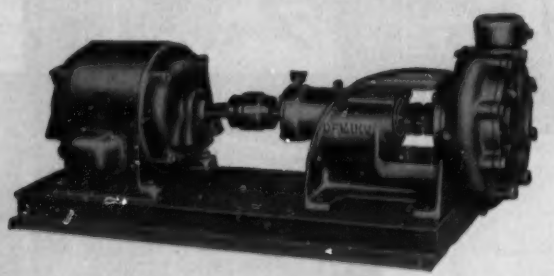
*Tote and Tote System Reg. U.S. Pat. Off.

600 So. 7th, Beatrice, Nebraska

Deming Fig. 4011 Centrifugal Pump delivers 180° caustic solution at rate of 100 g.p.m. against 46-foot head for degreasing trays of hand tools.



Same load of hand tools is rinsed in wash water tank served by another Deming Fig. 4011 Centrifugal Pump at 100 g.p.m. against 46-foot head.



What's *Your* job for this Versatile Deming Pump?

Champion de Arment Tool Company, Meadville, Pa., has a dual job for two identical Deming Fig. 4011 End Suction Centrifugal Pumps. "CHANNELLOCK" pliers and other famous hand tools are manufactured by that company.

Degreasing and rinsing trays of these tools is the dual job serviced by the Deming Pumps, as illustrated in the above views. *What's YOUR job for this versatile Deming Pump?*

Optional features of Fig. 4011 make it readily and economically adaptable for handling a wide variety of liquids, including many corrosive materials.

Bulletin No. 4011-A gives all the facts. Ask for your free copy.

THE DEMING COMPANY • 525 BROADWAY, SALEM, OHIO

DEMING

INDUSTRIAL PUMPS

LITERATURE . . .

Refrigerating Machines, Absorption..... Carrier absorpt on refrigerating machine cools with steam or hot liquids. Can use it to cool water or chemicals or to condense vapors. Request 36 p. booklet.
168 *Carrier Corp.

Refrigeration, Vacuum, Steam Jet..... Typical uses are: food processing, drying, deodorizing, refining, cooling, distilling, filtering, dehydration, evaporating. Complete details available in Bulletin 1462.
474 *C. H. Wheeler Co.

Towers, Cooling.....Stainless—2—150 tons. Suitable for indoor or outdoor location. Quiet operating. Marlo heat transfer equipment now available to your specifications. Request further information.
363e *Marlo Coil Co.

Towers, Cooling.....Special features: superior shaft seals, heavier bearings, more conservative horsepower ratings, more rigid housing & more positive lubrication. Request copy of Pritchard Cooling Tower brochure.
L437 *J. F. Pritchard & Co.

Traps, Steam..... Give faster, more effective condensate removal. Powerful valves action, positive shut-off, high capacity & each unit service tested. For more details, request new Bulletin No. 10-55.
164 *W. H. Nicholson & Co.

Traps, Steam.....Yarway 20-A Impulse Steam Trap has light load applications in: refineries, chemical and processing plants, power plants, hospitals, schools and institutions, laundries. Request Bulletin T-1729-X.
315 *Yarnall-Waring Co.

Washers, air.....Stainless steel air washers custom built to your specifications for: washing, cleaning, humidifying, dehumidifying, heating, and cooling. Air volumes from 600 to 76,000 CFM. Details.
363b *Marlo Coil Co.

Instruments & Control

Analyzers, Oxygen.....Beckman Oxygen Analyzers available for time-saving, accurate measurements of oxygen in your process or laboratory operations. Company makes general information available in Data File.
480 *Arnold O. Beckman Co.

Chromatographs, Gas.....Bulletin describes a new instrument employing the rapid technique of gas chromatography. Includes description of operation, applications and performance curves. Request Bulletin 482.
484A Beckman Instruments.

Comparators.....Fully illustrated, 100 p. tells how to use pH and chlorine control for water supplies, process solutions, production processes in 34 basic industries. Also covers complete line of comparators.
B402 *W. A. Taylor & Co.

Controllers, Level.....New design of displacement-type liquid level controller eliminates both bearings and knife edges and provides extremely trouble-free controller for all services. Details in Bulletin 456-1.
484B Kieley & Mueller.

* From advertisement, this issue.

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the product.

Controllers, Pneumatic . . . . . Bristol's Series 500 controllers are available for automatic control of temperature, pressure, vacuum, draft, absolute pressure, liquid level, humidity, pH value, etc. Request data.
326 *Bristol Co.

Controllers, Temperature. . . . . These temperature controls are simple, inexpensive, dependable, effective. Suitable for about 85% of your jobs—all but those calling for elaborate, costly control. Details.
229 *Sarco Co.

Controllers, Temperature. . . . . New series of indicating temperature controllers offer high accuracy, are rugged, easy to read, and are unusually convenient to adjust and service in the field. Details available.
485A Fenwal Inc.

Controls, Temperature . . . . . Features: cuts initial control costs; costly production stoppages; control maintenance costs. Controls for gas, liquids & solids in —30°F. to 1200°F. ranges. Condensed Catalog CC.
486 *Partlow Corp.

Controls, Thermal. . . . . Catalog gives details and complete product listings on Thermoswitch Thermal Controls, including midget and miniature versions of these units and snap-action controls. See Catalog 500.
167 *Fenwal Inc.

Detection Equipment, Gas. . . . . New specification sheet describes J-W Models E and EE, Combustible Gas Detection Equipment, and Sample Drawing Accessory. Gives also operational and construction data.
485B Johnson-Williams.

Detectors, Chlorine. . . . . Solvay Chlorine Detector monitors a continuous controlled sample of air, warning when chlorine concentrations in the air exceed 3 p.p.m. Complete information available upon request.
485C Wallace & Tiernan.

Gages. . . . . New line of small-size gages feature: 5 inch illuminated scales; independent, interchangeable units; multiple or individual mounting; easily mounted; pointer motion reversible. See Bulletin V5.
344 *Republic Flow Meters Co.

Gages, High Pressure. . . . . Strahman high pressure gages are used in refineries and chemical plants throughout the world. Company makes further information available in complete catalog. Request your copy.
R491 *Strahman Valves.

Gages, Liquid Level . . . . . Completely illustrated 76 p. reference describes the entire line of Penberthy liquid level and water gages . . . and also indicates their numerous points of superiority. Request Catalog 35.
74a *Penberthy Mfg. Co.

Gages, Vacuum. . . . . With 6 ranges covering pressures from 100 mm. to 0.1 micron. Equally ideal for the laboratory & production floor. It is precisely accurate & nearly immune to abuse. For details, see Bulletin G-20.
365e *National Research Corp.

Generators, Signal. . . . . Company offers information on their Signal Generator, Type LG-20 designed for test & alignment applications in the IF, broadcast, police, marine, & amateur bands. Catalog L4020.
485D Radio Corp. of America.

Indicators, Sight Flow. . . . . Literature describes the new line of sight flow indicators . . . easily and inexpensively installed in any new or existing pipe line ¼" to 2" N.P.T. Request detailed Date Unit.
R496 *Jerguson Gage & Valve Co.

Instruments, Humidity Recording. . . . . New bulletin describes & illustrates company's complete line of humidity recording & controlling instruments, as well as accessories. Request Bulletin No. H1009.
485E Bristol Co.

* From advertisement, this issue.

NEW!

The DINGS DYNAMIC way to remove tramp iron from rapidly moving material

DYNAMIC PERMA-PLATE MAGNETS

FOR BETTER MAGNETIC SEPARATION IN CHUTES, SPOUTS, DUCTS

Positive removal of tramp iron *from rapidly moving* material is assured by Dings new *Dynamic* Perma-Plate Magnet design. The revolutionary step face provides a recessed holding zone out of the direct path of the burden to hold iron firmly. Wide gap between poles attracts more iron from greater distances through rapidly flowing material.

Here's why new DYNAMIC Perma-Plate Magnets are better

1 The new Dings DYNAMIC Perma-Plate is a plate-type of permanent non-electric Alnico magnet, designed to attract *moving* iron. This proven design is the result of hundreds of extensive *dynamic* tests . . . *not* based on previously used static tests.

2 As shown by illustrations (1) and (2), a *pull test* is a static test having negligible bearing on the magnet's ability to attract rapidly moving iron. It is not *dynamic* in its application.

3 Illustration (3) shows a *lift test*, again a static test having negligible bearing on the magnet's ability to attract moving iron. It is not *dynamic* in its application.

4 Illustration (4) shows a *chute test* . . . the only *true* test of a plate magnet's ability to attract rapidly moving iron. THIS IS THE DYNAMIC PRINCIPLE OF OPERATION OF THE NEW DINGS PERMA-PLATE MAGNETS.

These new powerful, permanent Alnico V magnets are "best by test" for separating tramp iron or iron of abrasion from chemicals, plastics, fertilizers, minerals, liquids and wet and dry solids of many kinds . . . wherever damage to processing equipment or contamination of product purity is a problem. They are simple to install in existing wood or metal chutes and ducts without expensive alterations . . . or Dings can furnish a complete double-pass spout magnet assembly, as shown above. Four basic Perma-Plate types, each in 35 standard sizes from 4" through 72", meet every requirement.

DINGS MAGNETIC SEPARATOR COMPANY

4730 W. Electric Avenue
Milwaukee 46, Wisconsin

PP356-7/3

Send for Catalog 1205-D for installation suggestions and design details.

Backed by Dings — Magnetic Separator Leader for 50 Years

Dings

MAIL COUPON TODAY . . .

DINGS MAGNETIC SEPARATOR CO.
4730 W. Electric Ave., Milwaukee 46, Wis.

Please rush Catalog 1205-D and further details about the new Dings Dynamic Perma-Plates.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

RUGGED...

but extremely SENSITIVE!

PARTLOW TEMPERATURE CONTROLS are built to withstand rough usage, but they're also extremely sensitive to slightest temperature changes. They'll take a lot of punishment without upsetting their accuracy and precision.

If your process requires precise temperature control in the –30°F to 1200°F range, you can do it better . . . and at lower cost . . . with Partlow Controls.

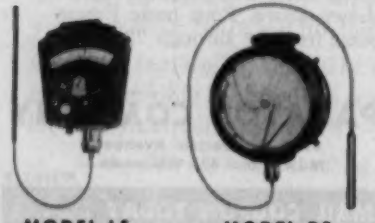
They're less complicated than thermocouples. Thick-walled capillaries and seamless tubing assure almost indefinite life. Elements can be replaced on the spot.

What's your control problem?

Tell it to Partlow!

THE PARTLOW CORP., Dept. E-1156
New Hartford, N. Y.
Offices in All Principal Cities

SEND FOR THIS **FREE** CONDENSED CATALOG



MODEL LS
Indicating Temperature Control

MODEL RS
Recording Temperature Control

partlow

the pioneer in mercury thermal controls

NO MATTER WHAT YOU MAKE, PARTLOW CONTROLS WILL HELP MAKE IT BETTER

LITERATURE . . .

Metering Systems.....New 11 p. illustrated bulletin describes "Fluidometer", a volumetric automatic metering system. Includes descriptions, diagrams, & illustrations of Fluidometer's features. Bulletin FL-56.
486A Hetherington & Berner.

Meters.....Rockwell stainless steel meters measure corrosive liquids fast. Now available for foods, pharmaceuticals, chemicals and liquors. Company makes complete information available in product bulletins.
355 *Rockwell Mfg. Co.

Meters, Flow.....Hagan Ring Balance meter can do the work of a meter, recorder, computer and controller—simultaneously. Detailed information included in brochure of products and services. Bulletin GSP-901.
160 *Hagan Corp.

Meters, Flow.....Multi-valve Fluidometer installations are available either jacketed or unjacketed and are "tailor-made" to fit the particular job. Company makes details available in Bulletin F1-56.
B507a *Hetherington & Berner.

Monitors, Impulse.....Damol Corp. introduces first safety shutoff and alarm for automatically controlled processes which requires no sensing elements or electronic circuitry. Complete details in Catalog 256.
486B Damol Corp.

Potentiometers.....Company offers bulletin describing their Series 184A Transmitting Potentiometer Pyrometer and Series 184E Transmitting Potentiometer Millivoltmeter. Includes applications, etc. Bulletin MTT810.
486C Manning, Maxwell & Moore.

Potentiometers, Transmitting.....Measure & control thermocouple temperatures or the signal from such devices as pH amplifiers, gas analyzers, etc. High accuracy in process temperatures control. Bulletin MTT810.
90 *Manning, Maxwell & Moore.

Recorders, Temperature.....Newly designed Model "1000" Auto-Lite Recorder offers: 6" clear reading chart, various standard ranges from –40 F. to +550 F., three standard types. For details, request catalog.
T435 *Electric Auto-Lite Co.

Regulators.....Company offers information on Norwalk Service Regulators for control of pressures & flow rates in service line installations. Includes descriptions & diagrams. Bulletin No. descriptions & diagrams. Request Bulletin No. 7500M.
486D Norwalk Valve Co.

Regulators, Voltage.....Stabiliness type TM (Tubeless Magnetic) regulators have no tubes to replace . . . no transistors . . . no moving parts to wear out. Company makes details available in Bulletin S157.
397 *Superior Electric Co.

Samplers, Air.....New bulletin describes the "M-S-A Fixt-Flo Sampler" which provides a simplified solution to air pollution measurement. Versatile instrument permits use of a variety of filters. Bulletin 0810-2.
486E Mine Safety Appliances Co.

Switches, Control.....New brochure covers the latest addition to the Dillon line of precision instruments, the Dillon Force Control Switch. Includes all nine capacities & complete price list. Bulletin 28E.
486F W. C. Dillon & Co.

*From advertisement, this issue.

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the product.

Thermocouples.....New 14 p. bulletin describes company's latest line of miniature protected thermocouples. Includes listings of calibrations & temperature ranges available, immersion lengths, etc. Bulletin No. 5.
487A Thermo Electric Co.

Thermostats.....Offer condensed catalog on miniaturized & surface-mounted thermostats. Presents physical, electrical & performance data required for specifying types of Thermoswitch controls. Catalog MC-124A.
487B Fenwal, Inc.

Time Components, Duplex.....Duplex Time Component is unique device consisting of an accurate synchronous electric time unit combined with a spring driven time unit held in reserve. Literature and details.
487C Industrial Timer Instruments.

Transmitters, Differential Pressure..... The new Taylor Fixed Range Differential Pressure Transmitter (200TD 111) provides an excellent, economical means of measuring flow, liquid level, or pressure. Bulletin 98274.
76 *Taylor Instrument Cos.

Transmitters, Pneumatic Pressure..... The Series 1250 Ashcroft pneumatic pressure transmitter is available with pressure sensing elements in all standard pressure ranges & Bourdon tube materials. Bulletin 340.
70 *Manning, Maxwell & Moore.

Transmitters, Temperature.....Bulletin explains why Foxboro M/12A Temperature Transmitter gives better performance with lower installation and maintenance cost. Full details contained in Bulletin No. 13-17.
52-3 *Foxboro Co.

Transometers.....New bulletin shows how to meter, integrate and control with Askania Transometer. Describes flow, indication, recording and control applications for fuel oil, viscous & other liquids. Bul. 301.
463 *Askania Regulator Co.

Pipe, Fittings, Valves

Accessories, Hose.....New 8 p. illustrated booklet covers all LE-HI Hose Couplings, Hose Clamps, Hose Nipples, Manifolds and Valves, giving information about type, size and classifications. Catalog No. 18.
487D Hose Accessories Co.

Coils, Expansion.....Bulletin describes Type X direct Expansion Coils, giving specifications, features, coil ratings, basic rating curves, dimensions, sizes, coil nomenclature, etc. Request Catalog No. 403.
487E McQuay, Inc.

Couplings.....Falk Steelflex Couplings will prolong machinery life and save money. They are versatile, efficient and economical. Engineering bulletin includes selection and dimension tables.
314 *Falk Corp.

Couplings.....Bulletin describes "Snap-Tite HK" coupling, which introduces quick coupling for acids, alkali and high pressure steam. Performs through —100 F to a +500 F temperature range. Bulletin #270.
487F Snap-Tite Inc.

Elbows, Reducing.....Offer important advantages in both piping design & piping cost. Need only 2 welds instead of the 3 required by a standard elbow & a reducer. For full details, request Catalog No. 54.
343 *Midwest Piping Co.

Fittings.....Bulletin describes Lenz "O-Ring" tube fittings, which eliminate flaring, threading, welding & soldering. Also includes description of hydraulic tubing, tube cutters, tube benders, etc.
487G Lenz Co.

*From advertisement, this issue.

IS YOUR PROBLEM:

WEAR plus severe CORROSION?

Then you'll be interested in investigating Kennametal* Grade K501

Kennametal Grade K501, a platinum bonded tungsten carbide, was developed especially to meet conditions where severe abrasive conditions as well as corrosive agents are encountered. While K501 equals the corrosive resistance of the noble metals, it is lower in cost, and has a much higher resistance to wear.

Here are results of laboratory corrosion tests, showing comparisons with other metals which were developed specially for corrosion resistance:

	STRENGTH % by WT.				TEMPERATURE				LOSS† mg/dm/d			
SOLUTION	Kennametal K501	Monel Metal	Hastaloy B	Kennametal K68	Kennametal K501	Monel Metal	Hastaloy B	Kennametal K68	Kennametal K501	Monel Metal	Hastaloy B	Kennametal K68
Nitric Acid (HNO_3)	5	Above 1	—	5	Boiling	Above 80°F	—	Room	0	Not	—	587
Sulfuric Acid (H_2SO_4)	5	Above 20	10	5	Boiling	Boiling	Boiling	Room	0	Recom-	85	161
Hydrochloric Acid (HCl)	1.25	All	10	5	Boiling	Above 120°F	Boiling	Room	74	mended	77	245

†Tests of one week duration

Note: The above tests are indicative of what may be expected in service, but it is recommended that specific tests under specific conditions be made.

In addition to its unusual abrasion and corrosion resistance properties, Kennametal K501 has a Hardness of 91.8 Rockwell A, Transverse Rupture Strength of 125,000 psi, and a Specific Gravity of 15.50. These unique properties suggest its use in valve parts, nozzles, seal rings, balls, nonlubricated guides and bushings, and other parts exposed to strong mineral acids, fuming nitric acid, and similar highly corrosive agents.

Made by Kennametal's exclusive methods of powder metallurgy, K501 can be produced in many complex shapes to close tolerances to meet the requirements for specific parts. It can be fastened by brazing.

Why not investigate Kennametal K501? It may be the answer to your problem. Write KENNAMETAL INC., Dept. CE, Latrobe, Pennsylvania.

*Kennametal is the trademark of a series of tungsten and titanium carbides which have exceptionally high resistance to the destructive forces of abrasion, corrosion, erosion, deflection, deformation, high temperature oxidation and impact.

B-5999

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Tomorrow's
MODERN DESIGN
for
Today's Demands!

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keep the aluminum industry rolling toward

GREATER CAPACITY

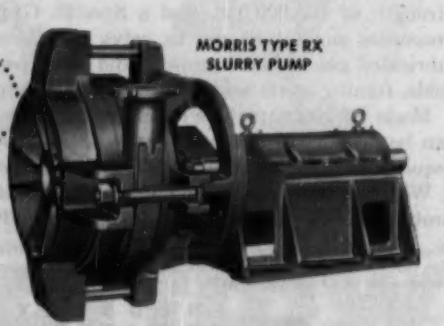
In pace with the far-sighted aluminum industry, other leading manufacturers the country over shrewdly specify Morris for heavy duty pumping.

The Morris Type RX Slurry Pump is rugged, dependable, and trouble free. It's specifically designed for heavy pumping; gives peak performance under all conditions, including heavy, coarse or fine slurries, dispersions and sludges.

The Morris pump operates with minimum attention . . . lowers maintenance costs . . . can be quickly dismantled for inspection . . . avoids lengthy lay-up time. For heavy duty pumping . . . specify Morris.

WRITE TO MORRIS TODAY for recommendations of the pump best suited to your size, capacity, specifications. Ask for Bulletin 185.

MORRIS
CENTRIFUGAL
PUMPS



MORRIS TYPE RX
SLURRY PUMP

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Sales Offices in Principal Cities

LITERATURE . . .

Fittings, Stainless Steel.....New stainless steel fittings will assure you of long, trouble-free service in tough piping applications . . . will reduce down-time and cut maintenance costs. Bulletin No. S-3-55.
403 *Watson-Stillman Fittings.

Hose, Metal, Flexible.....Produced in various alloys of stainless steel—in monel, bronze, and carbon steel. Ideal for use with high temperature and high pressure corrosive gases and liquids. Bulletin 21-A.
137 *Atlantic Metal Hose Co.

Nozzles.....Company offers information concerning a new compact pneumatic atomizing nozzle, for applications where space is at a premium. Supplied in a wide range of capacities in choice of sprays. Data Sheet 6552.
488A Spraying Systems Co.

Pipe Installation, Glass.....Pipe is easy to install & low in installed cost compared with other corrosion-resistant materials. Available in 6 standard sizes from 1- to 6-inch. I.D. inclusive. Installation Manual PE-3.
54-3 *Corning Glass Wks.

Pipe, Plastic.....Ace Rivivor is a new rigid threaded plastic pipe with good aging & high impact strength. Not affected by most inorganic acids & alkalis. Excellent for many organics. Request Bulletin CE-56.
396d *American Hard Rubber Co.

Pipe, Plastic.....General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170° F . . . except few strong acids & organic solvents. Tough, odorless, tasteless. Bulletin No. 80.
396b *American Hard Rubber Co.

Pipe, Plastic.....Polyvinyl Chloride is the unparalleled material for plastic pipe. It's a high quality unplasticized-rigid pipe designed to do a better job than any other material. The full story in Bulletin 24.
318 *U. S. Steel Corp.

Pipe, Saran Lined.....Saran lined pipe, fittings and valves cut corrosion costs . . . can be cut in the field with available pipe fitter's tools. Liquid never touches metal in saran lined pipe. Request details.
84 *Saran Lined Pipe Co.

Sockets.....Offer several types of sockets: standard length, bolt clearance length, magnetic, Flexockets, power, power-impact and thin-wall. Makes available catalog of industrial wrenches and hand tools.
426 *Snap-on Tools Corp.

Tubing.....Feature seamless and Weldrawn (fusion welded from strip and cold-drawn to re-crystallize the weld area). Published list—Data Memorandum No. 1 and other literature gives details about specific analyses.
488B Superior Tube Co.

Tubing, Laminated.....Illustrated data sheet describes "Poro-Tube", a new laminated tubing with exclusive feature of porous wall construction. Complete technical description is given. Technical Data 221.
488C Lamtex Industries.

Tubing, Plastic.....Excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. For details, request Bulletin No. 66.
396e *American Hard Rubber Co.

Tubing, Stainless Steel.....Wide range of B&W seamless and welded stainless tubing and pipe available. This tubing is custom-produced and will meet your fabrication, production and service requirements. Bulletin 1.
386 *Babcock & Wilcox.

* From advertisement, this issue.

Tubing Supports.....Company offers information concerning a new tube fitting anchor or mounting stud, a bolt type adapter made in both the Intru-lok & Triple-lok styles; flareless & flare type fittings, respectively.
488D Parker Appliance Co.

Valves.....There's an Ace hard rubber, rubber-lined, or plastic-lined valve for every corrosion application. Sizes from 2" to 24". Diaphragm gate and check types. Lists chemicals handled in Bulletin CE-52.
397c *American Hard Rubber Co.

Valves.....'Sentry" Models 1200, 1700 & 1800, & 3000 are patented quick-closing latch type & quick-opening piston type. All are full flow valves. Sizes run from 1¼ to a full 8 in. For full information request Bulletin 500.
99 *Coppus Engineering Corp.

Valves.....Available in 18-8 SMo and Cranoloy 20 . . . in gate, globe, angle and check patterns . . . ¼" to 6" . . . screwed or flanged ends. Rated 150 p.s.i. at 500° F. For details, see Circular AD-2030.
387 *Crane Co.

Valves.....Company offers information on their "Norwalk Meter Cop", a combination back pressure & anti-suction valve, including description of how it works, etc. Request your copy of Bulletin No. 4000.
489A Norwalk Valve Co.

Valves.....Golden-Anderson designs and manufactures valves that give dependable operation . . . that need little maintenance . . . that last a lifetime. Technical bulletins describing line are available.
B502 *Golden-Anderson.

Valves.....LQ600 Valves practically eliminate maintenance costs. Tests show many of these valves have served for five years without replacement, regrinding, maintenance, or leakage. Request literature.
69 *Lunkenheimer Co.

Valves, Back Pressure ..... Company offers information on the Cupola Back Pressure Valve for Cupola Aire Lines, including diagrams of operation, installation, and dimensions. Request Bulletin No. 10000.
489B Norwalk Valve Co.

Valves, Butterfly.....In this new Catalog you get the complete dimensions, layout drawings, specifications and materials for all pressure ratings of R-S Butterfly Valves that are now standardized. Catalog 160.
398 *S. Morgan Smith Co.

Valves, Check.....Durabla Check Valves are low in cost while being high in quality. Available in seven standard line sizes, from ¼" to 2". Company makes complete details available in Bulletin No. CE-116.
428 *Durabla Mfg. Co.

Valves, Check.....Company offers information on their Norwalk Diaphragm Operated Check Valve for Gas-Oxygen Service. Includes description, operation and diagrams. Request Bulletin No. 3000.
489C Norwalk Valve Co.

Valves, Check.....Multi-purpose check valve outperforms—outwears other valves—costs less to maintain. Produced in numerous metals and alloys as well as polyvinyl chloride. Details available in bulletin.
21 *Techno Corp.

*From advertisement, this issue.

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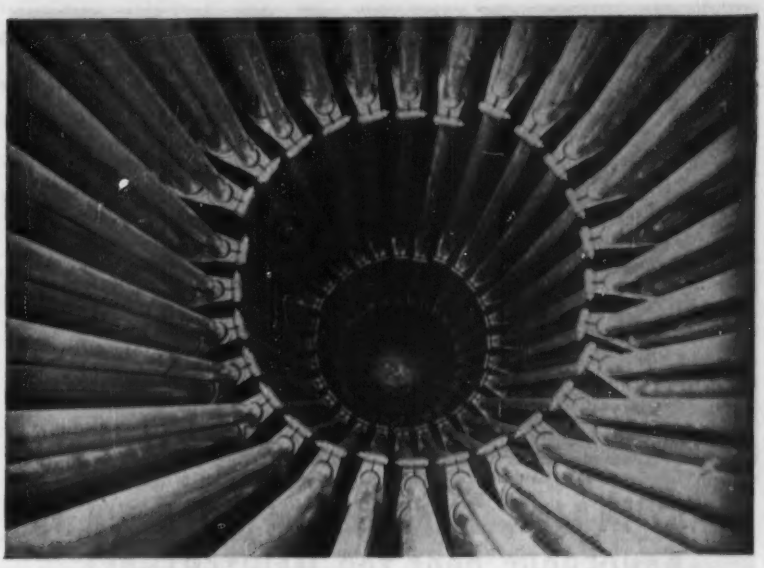
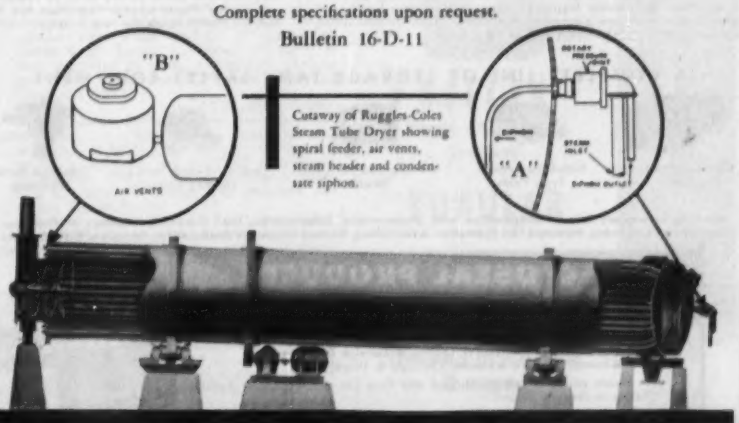


Ruggles-Coles STEAM TUBE DRYERS

- Ruggles-Coles Steam Tube Dryers have been supplied fabricated of aluminum, nickel, monel, inconel, stainless steels and other alloys to provide protection against corrosion and contamination. All fabrication is to code requirements.
- The continuous siphon discharge of condensate is independent of speed of rotation of the shell. (See "A")
- Automatic air vent for each tube eliminates loss of tube heating surface at the feed end of the dryer. (See "B")
- These extra advantages of the Ruggles-Coles Dryer mean continuous maximum output without operating attention and elaborate control devices.

Complete specifications upon request.
Bulletin 16-D-11


"B"
AIR VENTS
Cutaway of Ruggles-Coles Steam Tube Dryer showing spiral feeder, air vents, steam header and condensate siphon.
"A"

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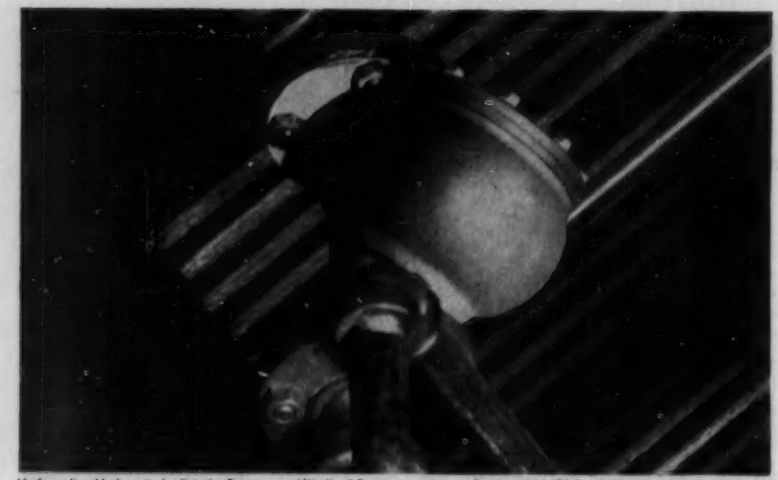


Underwriters' Laboratories lists the Protectoseal "in-line" flame arrester vent for use within 50 ft. of the open end of vent lines."

THIS "IN-LINE" TANK VENT PUT AN END TO DANGEROUS ROOF-TOP MAINTENANCE!

The above illustration shows the "in-line" vent located inside the tank house some 20 ft. from the open end of the line. This avoids frequent, costly and highly dangerous roof-top inspection formerly necessary where vents were installed outside at the end of the vent lines.

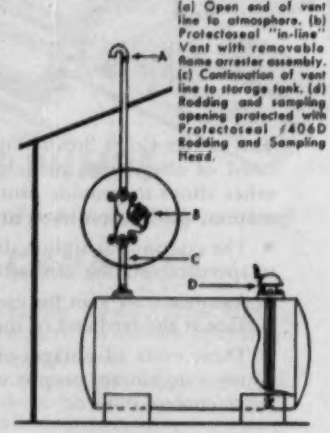
PROTECTOSEAL ENGINEERING SERVICES

The development of this "in-line" flame arrester vent is typical of Protectoseal design and engineering versatility. In providing proper fire and explosion protection, consideration is always given to the operating and maintenance problems of corrosion, sublimation, valve pressures, conservation of solvent vapors, cleaning of flame arresters and other special problems.

PROTECTOSEAL VENTING MANUAL

For a fuller understanding of how Protectoseal can help you solve your venting problems, fill out coupon below for your copy of the complete Venting Manual showing operating features and special applications of the complete Protectoseal line.

"The 1" in-line Flame Arrester Vent is approved for installations at distances up to 50 ft. from the open end of vent lines from flammable liquid storage and process tanks; 2" and larger sizes are approved for installation at distances up to 20 ft. from the open end of vent lines.



(a) Open end of vent line to atmosphere. (b) Protectoseal "in-line" Vent with removable flame arrester assembly. (c) Continuation of vent line to storage tank. (d) Redding and sampling opening protected with Protectoseal #406D Redding and Sampling Head.

Diagram shows actual installation of the Protectoseal "in-line" Flame Arrester Vent. Note how the vent is installed inside the tank house.

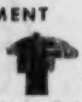
A COMPLETE LINE OF STORAGE TANK SAFETY EQUIPMENT

Conservation Type Vents

Non-Conservation Type Vents

Redding and Sampling Heads

Tank Truck and Tank Car Loading Covers



Storage Tank Fill Fitting

Working to prevent fires in cooperation with Underwriters' Laboratories, Inc., Associated Factory Mutual Fire Insurance Companies, National Fire Protection Association, Factory Insurance Association, Improved Risk Mutuals.

PROTECTOSEAL PRODUCTS PROTECT YOUR PLANT

The Protectoseal Company, Technical Service Department,
1968 South Western Avenue, Chicago 8, Illinois

Please send the Venting Manual with Price List and the Safety Bulletin Series as checked below:

- ☐ Protectoseal Venting Manual
- ☐ Safety Bulletin Series on "Flammable Liquids, their characteristics, hazards and safe handling"

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

LITERATURE . . .

Valves, Control.....New 8 p. condensed catalog of automatic pressure, temperature and level control valves, is made available, for automatic process control. Includes industrial applications. Bulletin 56C.
490A Atlas Valve Co.

Valves, Diaphragm.....Describes Grinnel-Saunders diaphragm valve with straight-through flow. Includes advantages, maintenance, design, selection of bodies and bonnets, etc. Fully illustrated, 4 p.
8 *Grinnell Co.

Valves, Diaphragm . . . . . Trouble-free plastic diaphragm valves—choice of general-purpose Ace-Ite, Ace Parian (polyethylene) or Ace Saran. Handles most corrosive chemicals & food ingredients. Bulletins 80 & 351.
396e *American Hard Rubber Co.

Valves, Diaphragm.....From antibiotics to the toughest acids, alkalis and salts, there is a combination of Hills-McCanna body and diaphragm materials that will best suit your needs. Request Valve Catalog 100.
370 *Hills-McCanna Co.

Valves, Drop Forged Steel.....GP valves are setting new standards of performance in petroleum refineries, chemical plants, power plants, and related industries. Request Supplement No. 1 (Catalog F-9).
174 *Henry Vogt Mach. Co.

Valves, Gate.....STV series straight-through gate valves are full-opening and have a short flow path for minimum impedance. Small installation space is required. For full information, see Data Sheet 10-20.
490B Consolidated Electrodynamics.

Valves, Lubricated Plug.....Low friction Teflon washer permits spring to turn with plug. Means less maintenance and longer life are assured, because spring is subjected to compression only. Book 39—Section 5.
357 *Homestead Valve Mfg. Co.

Valves, Lubricated Plug.....The design of the OIC lubricated plug valve prevents shank leaks and helps retain gland adjustment longer. Company makes further information available in new bulletin, Form 1003-R.
65 *Ohio Injector Co.

Valves, Mixing.....Company offers bulletin describing unique mixing valve that produces hot water from cold water and steam. Designated as Style D Mixer. Describes applications and operation. Bulletin 369.
490C Powers Regulator Co.

Valves, Packless . . . . . Fulton Sylphon Packless Valves assure greatest safety in handling hazardous materials, require no periodic maintenance, and practically eliminate downtime. Request Bulletin 813-VC.
85 *Fulton Sylphon Div.

Valves, Reducing.....New Leslie "Hi-Flo" reducing valve with capacity-regulation features never offered before. Have these advantages: fully balanced, drop-tight shutoff, trouble-free design. See Bulletin 553.
328 *Leslie Co.

Valves, Regulator, Temperature & Pressure.....OPW-Jordan valve, with the sliding gate, specifically designed to overcome wire drawing, valve leakage, poor control, chatter, excessive maintenance. See Bulletin J-180.
18 *Jordon Corp.

Valves, Solenoid.....New Release gives information concerning No. HV 44-816 new high pressure, heavy fuel oil, pilot operated solenoid valve. Includes complete description of outstanding features.
490D Automatic Switch Co.

Valves, Solenoid . . . . . Safety shut-off valveprovides tight seating . . . large flow capacity. Ideally suited for use as safety shut-off valve on gas and oil fired furnaces, ovens and boilers. Details in ASCO Bulletin 8022.
139 *Automatic Switch Co.

*From advertisement, this issue.

NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of both systems of fuel oil atomization are profitably yours . . . within the one new NATIONAL AIROIL Dual Stage Burner. 45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H. R. T., Scotch Marine and Water Tube Boilers, etc. Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g. p. h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get the detailed description, illustration and specifications in the NATIONAL AIROIL Bulletin 25.

PRODUCTS

OIL BURNERS and GAS BURNERS for Industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
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MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
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LITERATURE . . .

Valves, Solenoid.....Choose rugged industrial type Davis solenoid valves . . . for less downtime—less maintenance—more reliable control. For complete details of features, request copy of Bulletin 700.
L499 *Davis Regulator Co.

Valves, Stainless Steel.....Stainless Steel Valves Booklet illustrates and describes wide range of Jenkins globe, gate, check, and Y valves, includes selection data, survey forms. Request Form No. 200-A.
319 *Jenkins Bros.

Process Equipment

Acid Handling Systems.....Graver Vacuum Acid Handling System provides safe and simple method of handling any amount of acid that must be diluted with water. Further details available upon request.
491A Graver Water Conditioning Co.

Agitating Equipment.....Nettco units are engineered for low power consumption and high productivity. Will minimize maintenance with a minimum of moving parts—all conservatively rated. See General Catalog No. 551.
64a *New England Tank & Tower.

Agitators.....New design features for heavy duty Brine Agitators . . . totally enclosed fan-cooled motor driven Agitators include unique, patented centrifugal and vapor seals. Request Bulletin 10502-A.
491B Ruthman Machy. Co.

Airlocks, Rotary.....Mikro Rotary Airlock can be used at discharge of a puverizer or dust collector. Can also be used on the discharge of a blender or mixer to regulate flow of material. Details contained in bulletin.
241 *Metals Disintegrating Co.

Automation Equipment.....Tools of Automation consist of electric motors, variable-speed drives and controls. Key to greater production of more goods and services at lower cost. Request Bulletin A-1555-B.
44-5a *Reliance Elec. & Engrg. Co.

Centrifugals.....Batch-Master offers choice of perforate and imperforate baskets . . . corrosion-resistant materials . . . manual unloader if desired. Further information available in Bulletin TC-14-56.
481 *Tolhurst Centrifugals.

Centrifuges.....Sharples Super-D-Canter spans the wide range of particles from very large to those of only a few microns in size. Company makes complete information available in Bulletin 1254.
129 *Sharples Corp.

Centrifuges.....New 12 p. bulletin describes continuous solids discharge centrifuges and the method employed to effect high solids concentration and dryness of solids. For details, request Bulletin No. 1279.
491C Sharples Corp.

Crushers, Jaw.....Cast, steel, frame, manganese jaw & check plates. Large diameter shafts reduce shaft deflection & thus increase life of heavy-duty oversize roller bearings in bumper. Bulletin No. C12-B12.
436d *Denver Equipment Co.

Crushers, Jaw.....Eight models; range from 2 x 6 in. jaw opening to 12 x 26 in. Capacities to 80 tph. All except two smaller sizes operate on double cam principle-crush twice per energy unit. Request Bulletin No. 062.
310b *Sturtevant Mill Co.

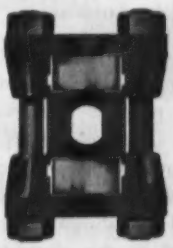
Crushers, Rotary Fine.....Five models available. Reduce 3 to 8 in. material to ¼ to 1½ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Request Bulletin No. 063.
310d *Sturtevant Mill Co.

*From advertisement, this issue.

Strahman

HIGH PRESSURE GAUGES

USED IN REFINERIES AND CHEMICAL PLANTS THROUGHOUT THE WORLD



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Gauge Cocks
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Large Chamber Reflex Gauges
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Heated or Cooled Gauges

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STRAHMAN VALVES, Inc.
16 Hudson St., New York 13, U.S.A.

Molded Hard Rubber proves best for.... Temperature and Corrosion Resistance

Another Corrosion Problem Solved by Luzerne

Above is shown a portion of a typical cell in Western Electric's Electroforming plant at their Point Breeze Works. This cell consists of a plastic lined metal shell with hard rubber weir plates fastened to each end. The feed weir shown is cored and connected to the electrolyte supply line by a flexible elbow.

Western Electric reports that a number of materials were considered for fabrication of these weirs and flexible elbows and it was concluded that hard rubber and neoprene provided the best combination of temperature stability, corrosion resistance, mechanical strength, ease of fabrication, and moderate cost.

Luzerne fabricates these hard rubber parts for Western Electric; they can solve your corrosion problem too. Write for information on Hard Rubber Molded Products, or send your problem for analysis by our engineering department.

The LUZERNE RUBBER CO.

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L. A. RUBBER & ASBESTOS WORKS
Los Angeles, Calif.

LITERATURE . . .

Crushers, Sample . . . . . Does the job quickly and efficiently. There is no loss of moisture content in sample. Any amount—from 0 to 20%—in one operation. Company makes literature available upon request.
T507 *American Pulverizer Co.

Cutters.....Bulletin describes Taylor-Stiles "Little Giant" dicing cutters or pelletizers. Describes three types, Light duty Series 100, Heavy duty Series 200 & Series 700 for pelletizing plastics for molding. App. 212.
492A Taylor, Stiles & Co.

Demisters.....New bulletin offered on Yorkmesh Demisters, for the separation of liquid and vapor phase materials. Contains engineering & installation data, chemical & petroleum applications, etc. Bulletin #18.
492B Otto H. York Co.

Discs, Rupture.....New D and DV Rupture Disc extends range for high temperature applications, provides maximum service under pulsating or reversing pressure conditions. Complete information in Catalog 77-21.
492C Black, Sivalls & Bryson.

Dryers.....Available in several types: direct heat, indirect heat, and steam tube. Let Deco engineers help solve your drying problem—no dryer problem too small or too large. Details in Bulletin No. D4-B2.
420j *Denver Equipment Co.

Dryers.....Offer a variety of dryer models to meet all problems. Designed to dry air, gases or liquids to sub-zero dew points at low cost. Constructed of quality materials. For details, see Bulletin D-100.
287 *C. M. Kemp Mfg. Co.

Dryers.....Compact, highly effective machine introduces dry, heated air through ever-changing channels reaching entire surface of every particle. Stratification and segregation are prevented. See Book 2611.
88 *Link-Belt Co.

Dryers, Rotary....."Davenport" Steam Tube Rotary Dryer reduces the moisture from wood chips prior to making them into Chip Board. Company makes further information available in their catalog.
B504 *Davenport Mach. & Foundry.

Dryers, Rotary.....Deliver top production, exacting performance, greater profits. Tells how Standard-Hersey has aided manufacturers throughout the world in solving their dryer problems in illustrated 12 p. Bulletin.
133 *Standard Steel Corp.

Dryers, Spray.....Cost-cutting features of Buflovak spray dryer: high recovery of solids, low initial cost, low cost of operations, easy to clean, low maintenance cost. For complete details, see Bulletin 373.
384 *Blaw-Knox Co.

Dryers, Spray.....Dryers to meet your requirements for large tonnage custom spray drying, small and large scale test runs and batch testing. Save in expense, time and labor through Nerco-Niro service. Bul. 232.
485a *Nichols Engrg. & Research.

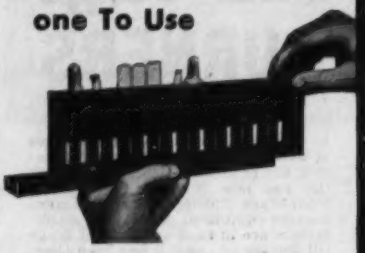
*From advertisement, this issue.

Keeping too busy?

You'll find our streamlined Reader Service section right up your alley. It's designed for busy engineers who want to find things fast, get more information fast. RS is easy to use, and you can bank on it.

TAYLOR COMPARATORS give QUICK, ACCURATE pH, CHLORINE TESTS

Complete, Compact Kit—Easy for Anyone To Use



Exact determinations of pH or chlorine content can be made in a matter of minutes with Taylor Comparators. Easy-to-use Taylor Comparators require no additional equipment or chemicals. Everything necessary to make tests comes with each comparator. Compact carrying case also available. No experience or technical knowledge needed. To test, simply fill the three tubes with the sample, add reagent to center tube, move color standard slide across until colors match and read value direct from slide.

All Taylor Comparators are durable, lightweight and portable; many serve for several determinations with only a change of color standard slides.

COLOR STANDARDS GUARANTEED

All Taylor liquid color standards carry an unlimited guarantee against fading. There's never any danger of mechanical inaccuracy. Each complete set of standards is mounted in a lightweight, durable, plastic slide. There are no fragile single standards to handle.

CALL YOUR LABORATORY SUPPLY HOUSE

for Taylor sets, or write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control . . . illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
414 RODGERS FORGE RD • BALTIMORE MD

CONFIDENTIAL

PLANT LOCATION FACTS

Where to find the labor skills you need

A suitable labor supply, with appropriate skills, is of prime importance in your plant location decisions.

Supplying all the facts about the labor potential at any site in New York State is our business. The data will be complete, accurate and current.

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COMMISSIONER OF COMMERCE

LITERATURE . . .

Dust Collectors.....Dustex Collectors are used throughout the food and chemical industries for the dry collection of fines without filter media. Full details available in Determination Test tbooklet.
T506 *Dustex Corp.

Dust Control.....Sly flat bag dust filters get all the dust. Pioneers and leaders in industrial dust control, they have a complete range of equipment for all process operations. Request Dynaclone Booklet.
418 *W. W. Sly Mfg. Co.

Dust Filters.....28 p. book explains in detail the distinguishing features of reverse jet filters. Contains schematic operating diagrams, performance curves for various types of dust. Request Bulletin No. 559.
461 **Day Co.**

Filter Leaf.....New "RIM-LOK" Filter Leaf provides simple closure of metal filter cloth in leaf frame without use of rivets, bolts or solder. Made of any commercial alloy. Bulletin 561 available upon request.
473 *Multi-Metal Wire Cloth Co.

Filter Paper.....Brochure enumerates dozens of commercial products and processes and tells you the specific grades of E&D filter paper that are most widely used. Valuable information available upon request.
B508 *Eaton-Dikeman Co.

Filters, Air..... New multiple-media Multi-Pak air filter was specially designed to offer higher air cleaning efficiency, higher dust-holding capacity in a mechanical filter. For details, see Bulletin No. 237.
161 *American Air Filter Co.

Filters, Automatic.....Filtration of raw water with an Adams AWF Automatic Filter can eliminate need for a pretreatment settling basin. Company makes complete details on these filters available in Bulletin 909.
155a *R. P. Adams Co.

Filters, Backwash.....You can clean Adams filters by operating a few valves . . . no time consuming or dangerous manual disassembly and cleaning necessary. If you have a chemical filtration problem, see Bulletin 431.
155b *R. P. Adams Co.

Filters, Disc.....Special patented design of segments in filters use both gravity & vacuum to give a drier filter cake. Drainage is complete & positive with no blow-back. Details contained in Bulletin FG-B1.
429f *Denver Equipment Co.

Filters, Pan.....New 2 p. two-color leaflet describes the unique features, operation, advantages and sizes of a new type pan filter. Also includes typical layout diagram. "Dorr-Oliver Traveling Pan Filter", Leaflet No. 8001.
493A Dorr-Oliver.

Filtration Units.....Company introduces new stainless steel Durco-Enzinger filtration station as portable package unit. Ideal for pilot plant or other small batch operations. Details available upon request.
493B Duriron Co.

Floats.....Harris Floats for any liquid, for high pressures, for high temperatures. Catalog presents data on various sizes, types of floats, and suitable metals for different corrosive liquids, temperatures.
BL498 *Arthur Harris & Co.

Graders, Precision.....Carter Precision Graders make separations to a degree of accuracy hitherto unobtainable because of the unique design of the perforated cylinders used. Folder available upon request..
78e *Hart-Carter Co.

Grinders.....By using new Motor-Driven Dexter Valve Reseating Grinder, you gain these benefits: savings as high as 400% on labor, increased production, fuel savings and power gains. Information available.
493C Leavitt Machine Co.

*From advertisement, this issue.

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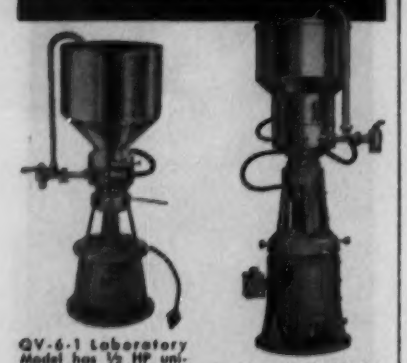

QV-6-1 Laboratory Model has ½ HP universal motor with 5 gal. stainless steel jacketed hopper or pressure head for direct feed.

VT-11 Production Model has 15 or 20 HP motor with 20 gal. stainless steel jacketed hopper.

Picking the proper colloid mill—for the best possible results in grinding, emulsifying and homogenizing—isn't always easy. For most colloid mills are "look-alikes"—on the *outside*.

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LITERATURE ...

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 1115.
84 *Traylor Engrg. Mfg. Co.

Mills, Ball.....A steel-head ball mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Bulletin No. B2-B13.
420b *Denver Equipment Co.

Mills, Colloid ..... Eppenbach Colloid Mills are easy-to-use, easy-to-clean, easy-to-install. They are an exceptional long-term investment in service, economy and efficiency. Request new catalog.
L494 *Gifford-Wood Co.

Mills, Grinding.....Illustrated literature describes a new type Fords industrial hammermill designed to handle a wide range of grinding, both fine and finish grinding, and product reduction in a variety of industries.
494A Myers-Sherman Co.

Mills, Imp.....The Raymond imp mill is equipped to handle almost any combination of pulverizing, blending, classifying, conveying and/or drying operation. For more complete details, request Catalog No. 77.
388 *Raymond Div.

Mills, Ring Roll.....Reduces hard or soft 1½ in. & smaller material to from 6 to 200 mesh. Grind only—no screens. Capacities of three models range up to 18 tph, depending on model & material. Request Bulletin No. 079.
310e *Sturtevant Mill Co.

Mixers.....Describes Super Agitators & Mixers. Patented standpipe around propeller shaft assures positive agitation & circulation. Patented wearing plate prevents sand-up on shut-down. Bulletin No. A2-B4.
420a *Denver Equipment Co.

Mixers.....Philadelphia Fluid Mixers offer more horsepower capacity per dollar & are easier to install & less expensive to service. Perform smoothly & economically. For complete story Bulletin A-156.
306 *Philadelphia Gear Works.

Mixers.....Company offers information on their Triple Action Mixer, the only mixer with exclusive triple mixing action. Describes features & gives Assembly diagram, specifications, dimensions, etc.
494B Strong Scott Mfg. Co.

Mixers.....Offers new addendum to technical supplement HM on use of "American" Homomix in chemical mixing without a mixing tank. Discusses general theory of mixing & cusses general theory of mixing. Request Addendum No. 1.
494C American Well Works.

Mixers, Clay.....Day mixers are ruggedly built, precisely engineered, for 24 hour operation. Available in 5, 200, 350, 550, 660, 1000 gal. pasting capacities. Full details are available in Data Sheet I-300 CM.
300 *J. H. Day Co.

Mixers & Feeders....."Chemical Mixers and Feeders" a new 8 p. brochure, with illustrations and diagrams includes descriptions and performance data on Infilco mixers and feeders. Request your copy.
494D Infilco, Inc.

Mixers, Horizontal Batch.....Horizontal Batch Mixer, Style "B", is ideal for rapid, intimate mixing of small percentages of a number of critical ingredients with large bulk of basic material or filler. Bul. 95.
289 *Sprout-Waldron.

Mixers, Pipe Line.....Company issues an informative booklet describing the Nettco Flomix . . . a patented and unique Pipe line mixer for continuous processing applications. Fully illustrated Bulletin No. 531.
64c *New England Tank & Tower.

*From advertisement, this issue.

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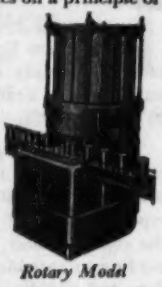

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PNEUMATIC

LITERATURE . . .

Mixers, Side Drive.....Presents 8 p. fully illustrated reference covering Nettco side drive with shut-off. Describes how the shut-off operates, numerous advantages, exclusive features, etc. Bulletin No. 532.
64b *New England Tank & Tower.

Presses, Filter.....Sperry Catalog, complete with charts, tables, and diagrams, will help you in the operation, maintenance and selection of filtration equipment. Request your copy of Catalog 7-E.
394 *D. R. Sperry & Co.

Process Equipment . . . . . Bulletin describes gyratory crushers, swing jaw crushers, tube mills, ball & rod mills, vibrating screens, rotary kilns, coolers, dryers, belts, conveyors, steam generators, waste heat boilers.
22-3a *Kennedy-Van Saun.

Process Equipment.....New 4 p. bulletin describes company's 4 classes of process equipment; equipment for food processing, for mills, for pulverizing, etc., & for oil milling & asbestos industries. Bulletin No. 56.
495A Bauer Bros. Co.

Process Equipment, Impervious Graphite ....."Karbate" impervious graphite process equipment offers: lower first cost, low maintenance, outstanding corrosion resistance, high thermal conductivity, etc. Literature.
277 *National Carbon Co.

Process Units, Turba-Film.....Unit will reduce original equipment investment, cut steam and operating costs, produce higher concentrate. Will solve many problems throughout chemical and process industries. Literature.
63 *Rodney Hunt Mach. Co.

Propellers, Fabricated....."Fabricated" propellers will do a perfect job of mixing, blending, stirring, pumping or aerating in applications requiring relatively low horsepower and not over 1750 LPM. Request catalog.
B435 *Michigan Wheel Co.

Purifiers.....Model LS Hi-eF Purifier will reduce cost of power operation and conserve water and steam. Installed in low pressure steam lines on exhaust side to remove oil, and other impurities. Bul. 201.
495B V. D. Anderson Co.

Reactors, Glassed Steel.....Offer a wide range of sizes . . . 5 to 4,000 gals.; several ways to adapt top-head openings, agitators, seals, and valves in meeting changing temperature and pressure requirements. Bul. 926.
514 *Pfaudler Co.

Rolls, Crushing.....Reduce soft to hard 2 in. & smaller material to from 12 to 20 mesh with minimum fines. Eight sizes: rates to 87 tph. Three types available: Balanced, Plain Balanced, & Laboratory Rolls. Bulletin 065.
310c *Sturtevant Mill Co.

Samplers, Automatic.....Heavy duty units, extra rigid track and ball-bearing wheels assure positive travel and timing of sample cutter. Available in stainless steel for acid and corrosive service. Bulletin 81-B4.
420c *Denver Equipment Co.

Screens, Gyratory.....All-metal unit is designed to separate dry granular materials into two, three and four predetermined sizes. Information on Allis-Chalmers gyratory screens in Bulletin No. 07B8446.
381 *Allis-Chalmers Mfg. Co.

*From advertisement, this issue.

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LITERATURE . . .

Separators.....Company offers information on their Power-Flo Separator, a new multi-purpose separating system in one compact machine. Includes assembly diagram, specifications, etc. Bulletin TSB6-586.
496A Strong Scott Mfg. Co.

Separators, Cylinder . . . . . Uni-Flow Cylinder Separators are recommended when you need less accuracy or more flexibility. Request folder that describes in detail the sizing methods of this machine.
78b *Hart-Carter Co.

Separators, Disc.....Carter discs size by length differences. Sizes of Carter disc separators differ in number of discs and in diameter of discs. Wide range of pocket sizes and styles. Request product folder.
78a *Hart-Carter Co.

Softeners.....Cochrane Zeolite Softeners automatically control every phase of the cycle . . . service, backwash, regeneration, rinse and back to service. Company offers complete details, in Publication 4520-A.
341 *Cochrane Corp.

Stills, Pot.....Company offers complete information concerning a new improved type of high vacuum pot still, which utilizes direct agitation of the distillant. Apparatus has vacuum range as high as .1 microns Hg.
496B Arthur F. Smith Co.

Tables, Concentration.....Separate materials into bands & handle coarsest sands with excellent results. Ideal for separation of groups of particles having similar range of specific gravities. Bulletin TI-B3.
420h *Denver Equipment Co.

Wire Cloth.....80 p. catalog describes company's facilities for fabricating wire cloth parts. Includes wire cloth parts for screening, filtering and special uses. Also provides helpful metallurgical information.
412 *Cambridge Wire Cloth Co.

Wire Cloth & Screen.....In order to improve your filtering, straining, sizing operations, specify Ludlow-Saylor wire cloth & screen. Give better resistance to heat & pressures. Condensed Screen Reference Catalog.
425 *Ludlow-Saylor Wire Cloth.

Pumps, Blowers, Compressors

Blowers.....4 p. bulletin contains selection charts & other useful engineering information pertaining to the "Standardaire" blower, a modern compressor adaptable to pressure or vacuum service. Bulletin B-154A.
496C Read Standard Corp.

Compressors.....Every Norwalk compressor is test-run for 8 hours, then taken down for complete inspection before re-assembly and shipment. Complete catalog describes compressors from single stage to six stages.
478 *Norwalk Co.

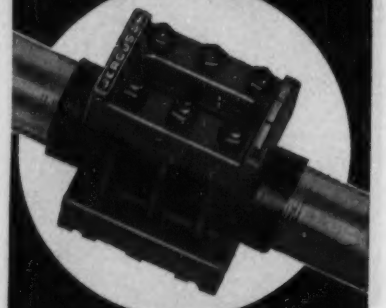
Compressors, Oil-Free.....Joy WG-9 oil-free compressors are equipped with carbon graphite piston rings. Need no lubrication, and compensate automatically for wear. For further information, request Bulletin 104-11.
7 Joy Mfg. Co.

Fans.....Improved Axiflo Fan to handle tough air, fume and vapor jobs efficiently, inexpensively, and with a minimum of maintenance. Sturdy, practical fan to handle more air for less horsepower. Catalog 1110.
496D Westinghouse Elec. Corp.

Lubricators.....New technical reference describes automatic lubricators featuring a newly designed constant pressure rotary pump. Discusses capacity, characteristics, rotary pump unit, applications, etc. Reference 55C.
496E Bijur Lubricating Corp.

*From advertisement, this issue.

NEW . . .
Jerguson
Sight Flow Indicators



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The special design of these new indicators results in a turbulence in the flow of liquid, making it easily visible. Several types of indicating vanes, installed within the chamber, may also be furnished, according to variable conditions of rate of flow and viscosity of liquid. For indication of minute flows, small Sight Flow Indicators with a rotating vertical rising ball are available.

Jerguson Sight Flow Indicators are soundly designed, carefully made, and are backed up by a company with over 40 years experience in the field. Available in Transparent and Reflex types, in a wide variety of materials and linings, and with Wedge Type Illuminators, Haveg Chambers, Non-Frosting Glasses, or other special construction.

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LITERATURE . . .

Pumping Units, Vacuum.....New 82-V vacuum pumping unit "with dry sight feed" will end liquid sight feed problems. Can be installed on any existing Manzel lubricator. Complete catalog available.
429 *Manzel Div.

Pumps.....Company offers two types of pumps for volume pumping and for great pressure . . . single-stage pump and double stage pump. See Bulletin 721.6 for single-stage pumps, Bulletin 722.6 for double-stage pumps.
432 *Goulds Pumps.

Pumps.....Handle most anything that can pass thru a pipe, from free-flowing liquids to non-pourable pastes—even materials containing relatively large particles or abrasives. Moyno Pump Bulletin No. 30-CE.
93 *Robbins & Myers.

Pumps.....Pump liquids, gases, slurries without corrosion or contamination. Wavelike motion of steel fingers forces material through tubing. Company offers catalog giving complete details.
TL 498 *Sigmamotor Inc.

Pumps.....Taber pumps are built for handling chemical solutions, efficiently & economically . . . in the processing industries. Details on horizontal pumps in Bulletin C-355, & for vertical pumps request Bulletin V-837.
L416 *Taber Pump Co.

Pumps.....If you have a problem where metering, blending or other accurate pumping of liquids is concerned, let Viking help solve it. Use Viking pumps for accurate pumping. Request information & Bulletin 568c.
B501 *Viking Pump Co.

Pumps.....A new 16 p. two-color catalog features Hills-McCanna Diaphragm Valves & Metering & Proportioning Pumps. Includes specifications, capacity tables, schematic diagrams, etc. Catalog 9G-56.
497A Hills-McCanna Co.

Pumps, Acid.....On most difficult pumping jobs . . . dependable highly efficient pumps deliver continuous, trouble-free performance on round-the-clock schedules wherever they are installed. Full details.
293 *A. R. Wilfley & Sons.

Pumps, Centrifugal..... Optional features of Fig. 4011 End Suction Centrifugal Pump make it readily and economically adaptable for handling a wide variety of liquids, including many corrosive materials. Bul. 4011-A.
484 *Deming Co.

Pumps, Centrifugal.....Choice of mechanical seals—or packing—with Standard End Suction Centrifugal pumps. Can easily convert from one to the other using standard stock parts. Bulletins W-300-B4 & W-350-B16.
95a *Worthington Corp.

Pumps, Centrifugal.....Catalog sheet describes the new Bart "Flex-Seal" Centrifugal Pumps. A special "rate of flow" chart clearly indicates the capacities & flow-rates of the models available.
497B Barts Labs.

Pumps, Chemical.....Lapp Pulsafeeder is a combination piston-diaphragm pump for controlled-volume pumping of fluids. Typical applications, flow charts, description and specifications in Bulletin No. 440.
267 *Lapp Insulator Co.

Pumps, Diffusion.....New A-2-P Air-cooled Purifying Diffusion Pump has speed, blankoff & forepressure tolerance ranking with best 3-in. diffusion pumps without complications of a water-cooled system. Data Sheet.
365a *National Research Corp.

Pumps, Direct Flow.....Simplicity of Aldrich Direct Flow design, with fluid-end sectionalization, offers substantial economies in operation and maintenance. Request condensed catalog and Data Sheet 100.
356 *Aldrich Pump Co.

*From advertisement, this issue.

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Write today for Harris Float Catalog with complete technical data.

FLOATS

LITERATURE . . .

Pumps, Double Suction.....Hydraulically balanced, highly efficient and durable, in sizes to deliver from 10 to 14,000 gpm for circulating, air conditioning, other plant services. Details in Bulletin 955-R.
434 *Buffalo Pumps.

Pumps, Jet.....New 19 p. catalog describes Penberthy jet pumps (ejectors, eductors, exhausters, syphons). Includes capacities, construction, installation, operation & maintenance information. Catalog No. 512R.
498A Penberthy Injector Co.

Pumps, Process.....DeLaval CPO-process pumps handle numerous liquids; salt brine; sea water; caustic solution; soap solutions; etc. Capacities to 2000 gpm—heads to 200 ft. Details in Bulletin No. 1125-B.
320 *DeLaval Steam Turbine Co.

Pumps, Process.....Peerless type DL & DM chemical process pumps feature: accessibility, durability, serviceability, interchangeability, reliability and availability. For complete details, see Bulletin B-1608.
361 *Peerless Pump Div.

Pumps, Rotary.....Wayne Pump Co. announces five new series of Internal Gear Rotary Pumps. Offer unparalleled versatility in field of positive displacement liquid pumps. Descriptive literature available upon request.
498B Wayne Pump Co.

Pumps, Rotary, Gas Ballast.....Equal any mechanical pump under ideal conditions but continues to do same job even when pumping 100% water vapor or many other condensable vapors. For details, see Data Sheet.
365b *National Research Corp.

Pumps, Rotary, Gear-Type.....Best for handling high-viscosity fluids as their large, unobstructed passages mean low entrance losses. Also, there are no valves or valve springs. Request Bulletin W-483-B2.
95b *Worthington Corp.

Pumps, Solids.....“Fluidizer” will convey most powdered materials as easily as water. Booklet contains story of fluidization and the “Fluidizer’s” application to industrial transporting of powdered solids.
313 *Superior Separator Co.

Pumps, Vacuum, Rotary.....Versatile pump available in capacities from 20 to 180 c.f.m. for any laboratory, development or production work. Company makes further information available in Catalog No. 90.
473 *Beach-Russ Co.

Vents.....Complete Venting Manual shows operating features and special applications of complete Protectoseal line. “In-line” vent avoids frequent, costly and highly dangerous roof-top inspection.
490a *Protectoseal Co.

Services, Processes, Misc.

Fire Protection.....28 p. covers various methods of fire detection, fire prevention, fire control and fire extinguishment associated with the field of “Special Hazard” fire protection. Fully illustrated Catalog 73.
498C “Automatic” Sprinkler Corp.

Flotation.....More large plants are installing “Sub-A’s” for entire flotation job, because they give maximum recovery at a low cost per ton. Dependable, simplified continuous operating. Bulletin No. F10-B81.
420g *Denver Equipment Co.

Laboratory Equipment.....Batch and continuous test models of crushers, screens, ball mills, pulverizers, rod mills, classifiers, agitators and mixers, pulp distributors, feeders, etc. Data in Bulletin LG1-B10.
420i *Denver Equipment Co.

*From advertisement, this issue.

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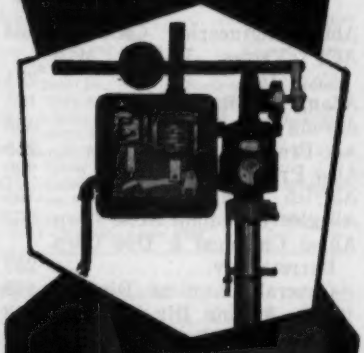

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499C Norton Co.

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L493 *N. Y. State Dept. of Com.

Plants, Nitric Acid.....New 4 p. two-color bulletin describes how efficient, low-cost production of Nitric Acid is possible. Includes typical operating requirements for Nitric Acid manufacture. Request your copy.
499D Fluor Corp.

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499E Aluminum Co. of America.

Processes, Silver Plating.....8 p. technical paper describes company's new Silvrex Bright Silver Plating Process. Covers in detail such topics as bath makeup and maintenance; anodes, tanks, temperature; agitation; etc.
499F Sel-Rex Precious Metals.

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499G Jerguson Gage & Valve Co.

Safety Equipment, Storage Tank..... Company offers Safety Bulletin Series on "Flammable Liquids, their characteristics, hazards and safe handling." Includes: conservation type vents, tank openings, etc.
499b *Protectoseal Co.

Water Well Systems.....Covers Layne water well systems, oil and water lubricated Vertical Turbine Pumps, special water well drilling, service work, shutter screens, irrigation wells and pumps, etc. See Bulletin No. 100.
499H Layne & Bowler.

Welds.....Company offers bulletin describing EB Weld Insert, its composition, available types, dimensions, procedure for welding pipes with the EB Weld Insert & Process; all features & specifications.
499I Arcos Corp.

*From advertisement, this issue.

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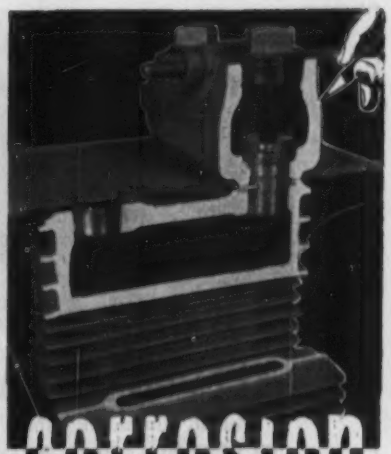

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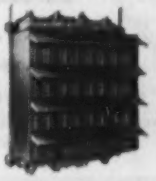

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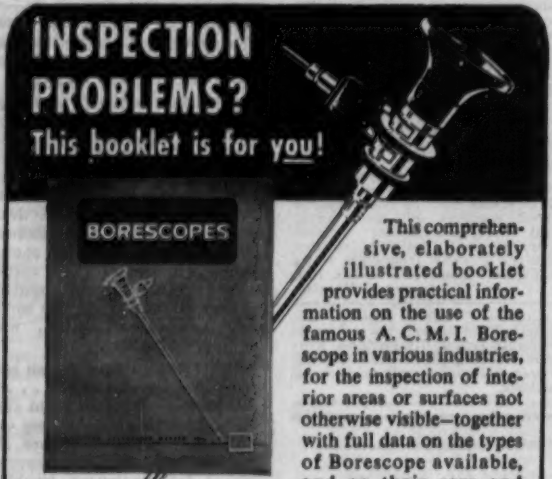

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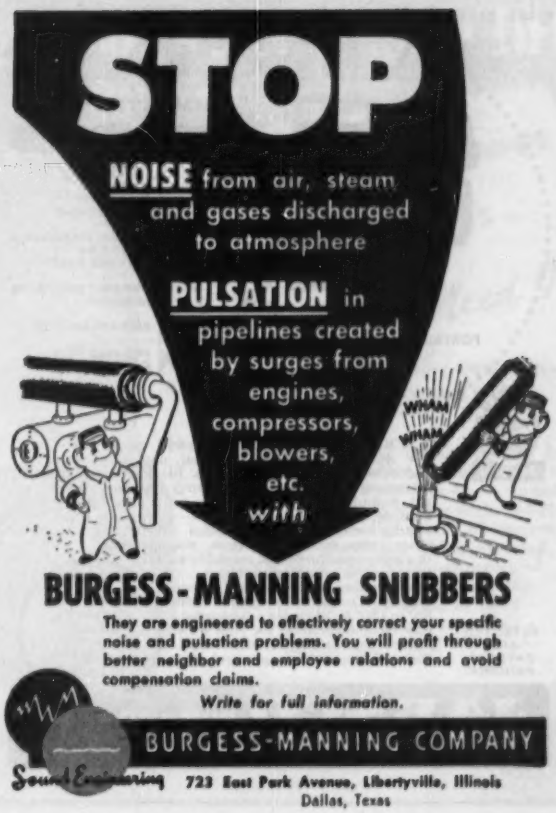
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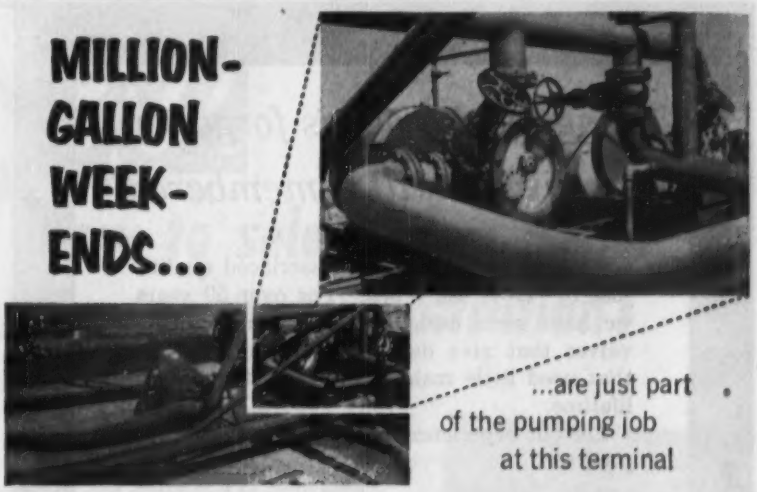

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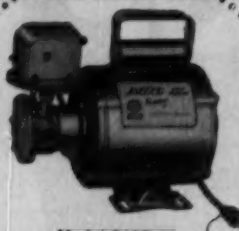

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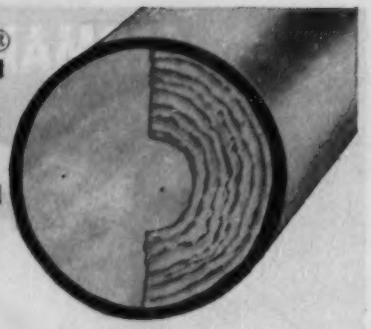

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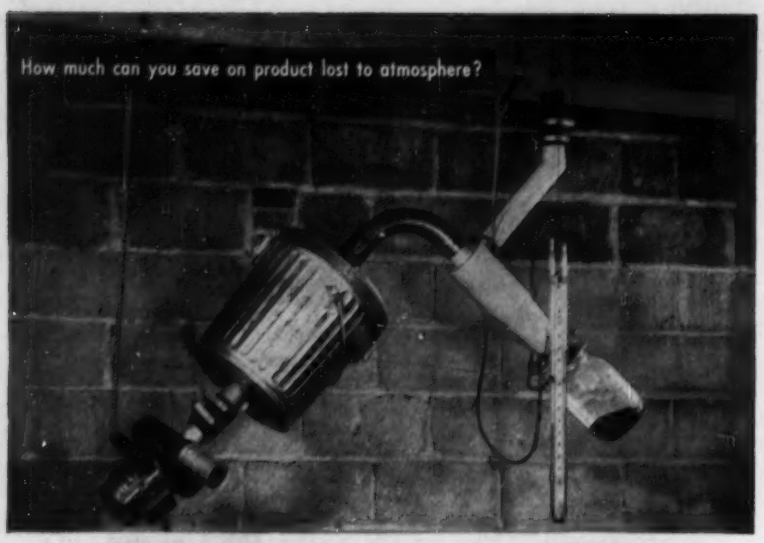

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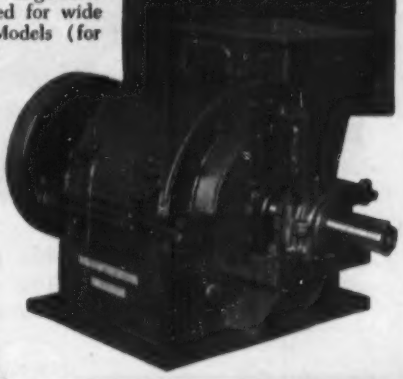

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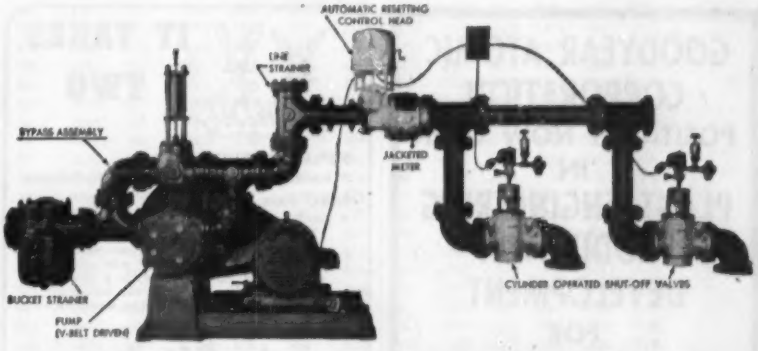

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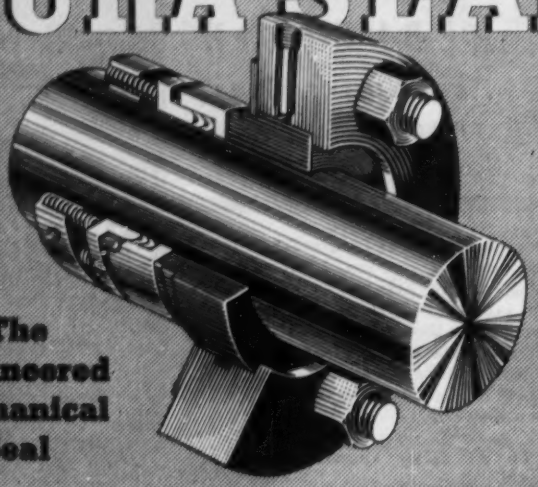

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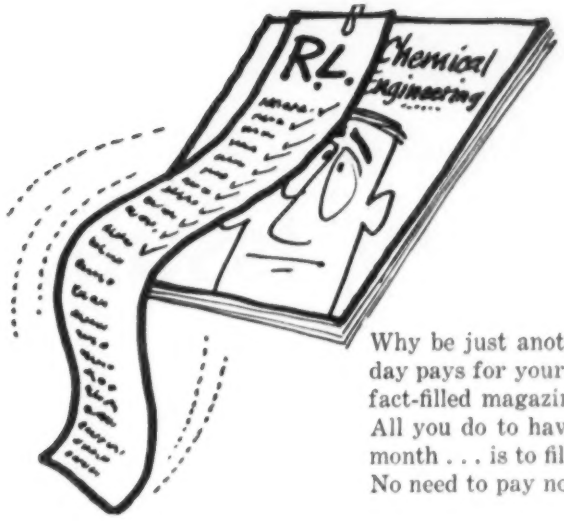

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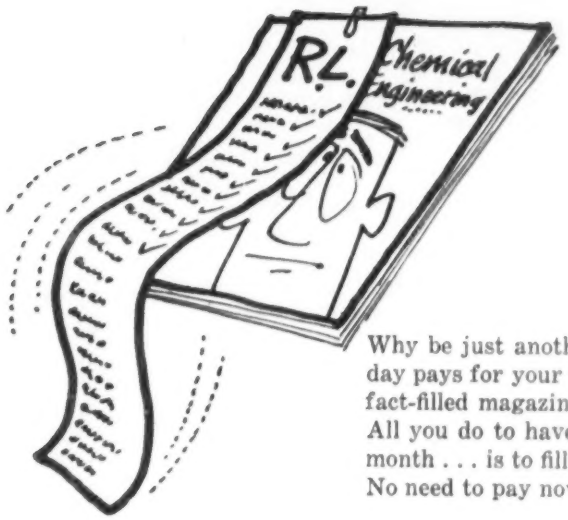

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10	50-1b	80b	142C	169b	272A	304d	348	397d	433	472G	477C	482H	490A	BL498	
11	52-3	81	143	172	272B	305	349	397e	434	472H	478	483	490B	TR498	
12	54-5	82	144A	173	272C	306	350	398	T435	472I	478A	483A	490C	498A	
13	56-7a	83a	144B	174	272D	307	352	399	B435	473	478B	483B	490D	498B	
14	56-7b	83b	144C	227	273	308	354	400	L437	473A	478C	483C	L491	498C	
15	56-7c	83c	146A	229	274A	309	355	401	458	473B	478D	483D	R491	L499	
18	56-7d	83d	146B	231	274B	310a	356	402	460a	473C	478E	483E	491A	R499	
19	56-7e	84	146C	233	274C	310b	357	403	460b	473D	478F	483F	491B	499A	
20	56-7f	85	146D	235	274D	310c	361	404	460c	473E	478G	484	491C	499B	
21	56-7g	86	148A	236-7	274E	310d	362	405	460d	473F	479	484A	L492	499C	
22-3a	56-7h	87	148B	239a	275	310e	363a	406	461	473G	479A	484B	R492	499D	
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22-3f	62	92	150D	246-7	276E	316	364	413a	465b	474C	480B	485D	R493	499I	
22-3g	63	93	150E	249	276F	317a	365a	413b	466	474D	480C	485E	493A	T500	
22-3h	64a	94	150F	251	277	317b	365b	414	467	474E	480D	486	493B	B500	
22-3i	64b	95a	150G	253	278A	318	365c	415a	468	474F	480E	486A	493C	T501	
22-3j	64c	95b	150H	255	278B	319	366	415b	469a	474G	480F	486B	L494	B501	
22-3k	65	95c	150I	257	278C	320	367	L416	469b	474H	480G	486C	R494	T502	
24-5	66	96a	151	259	278D	322	368	418	470a	474I	480G	486D	494A	B502	
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28-9	69	96c	153	265	280	324	370	420b	470A	474K	481A	486F	494C	B503	
32	70	97	154	266A	281	325a	381	420c	470B	575a	480B	487	494D	T504	
33	70A	99	155a	266B	283	325b	386	420d	470C	475b	481C	487A	L495	B504	
34a	71	100	155b	266C	285	326	387	420e	470D	475A	481D	487B	R495	T505	
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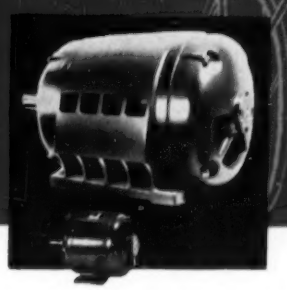

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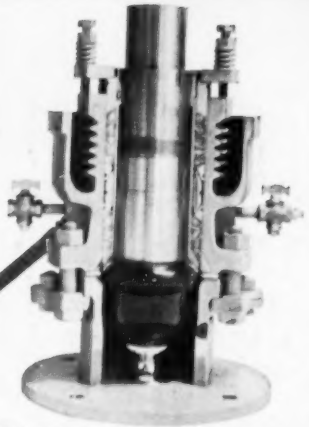
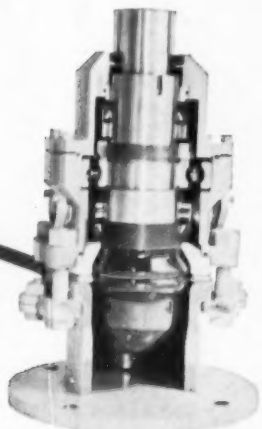


This Pfaudler stuffing box design answers most normal operating conditions. Inexpensive, easy to maintain, it has proved reliable over a wide range of operating conditions.



Pfaudler nonmetallic seal, while slightly more costly than design above, can be used for a higher range of temperature and pressure requirements.

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See advertisements on pages 16 and 17 of this issue also.